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# ORGANIZATION AND PRESENTATION OF ENVIRONMENTAL DATA FOR OFFICE OF CIVIL DEFENSE USE

A Feasibility Study



TECHNICAL REPORT NO. 5-622

April 1963

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U. S. Army Engineer Waterways Experiment Station  
CORPS OF ENGINEERS  
Vicksburg, Mississippi

## PREFACE

This report presents the results of a nine-month feasibility study of environmental data for Office of Civil Defense use. The U. S. Army Engineer Waterways Experiment Station (WES) was authorized to conduct the study by Project Order No. OCD-OS-62-233, dated 6 June 1962, from the Contracts Branch, Office of Civil Defense, Department of Defense, to the Office, Chief of Engineers, Department of the Army.

The study described in this report was conducted by the Geology Branch, Soils Division, WES. Dr. David D. Smith, School of Geology, Louisiana State University (under subcontract), was the principal investigator and prepared the text of the report. Mr. Roger T. Saucier of the Geology Branch assisted in various phases of the study and prepared the engineering-geologic map folio (Appendix D). The study was accomplished under the direct supervision of Dr. Charles R. Kolb, Chief of the Geology Branch, and the general supervision of Mr. W. J. Turnbull and Mr. W. G. Shockley, Chief and Assistant Chief, respectively, of the Soils Division, WES.

Director of the WES during the conduct of this study and preparation and publication of this report was Col. Alex G. Sutton, Jr., CE. Technical Director was Mr. J. B. Tiffany.

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## SUMMARY

The Office of Civil Defense (OCD) requested that the U. S. Army Engineer Waterways Experiment Station (WES) evaluate on a nationwide basis the present status of existing environmental data and data sources, and determine the feasibility of various possible methods for organizing and presenting such data for OCD use. Analysis indicates that OCD environmental data requirements are of two types: (a) detailed specific information, and (b) authoritative generalizations of relatively broad scope. The subject matter is highly variable; problems arise on relatively short notice, and generally require rapid solution. Further, a given data requirement is not likely to recur frequently, if at all. In addition, several lines of evidence show that advance preparation of data for possible use by the OCD is not presently feasible, except in carefully selected cases.

An appraisal of the status of existing environmental data held by the major cognizant Federal and state agencies indicates that voluminous, unpublished data in various stages of processing exist for all pertinent categories of information. The data are generally filed in local, state, or regional offices, and the practical difficulties in obtaining such information are significant. Adequate fulfillment of OCD environmental data requirements centers around establishing an effective organization structure which will facilitate communication and transfer of information from data sources to the user; in short, setting up a suitable information system.

Analysis of a variety of possible information systems indicates that those which appear to be feasible for OCD use include (a) a system based on a small in-house information center headed by a Staff Coordinator for Environmental Information, and (b) a system utilizing some type of non-manned, nonautomated data base such as a directory of environmental data sources. Accordingly, recommendations are made for establishing a three-part information system which would consist of (a) an OCD Staff Coordinator for Environmental Information who would be a professional earth scientist, (b) a Board of Expert Advisers representing pertinent environmental disciplines, and (c) a directory of Federal, state, and other important environmental data sources. The Staff Coordinator and the Advisory Board should be selected and appointed as soon as practical. Preparation of the directory of data sources would follow after a six- to twelve-month period.

during which the Staff Coordinator could determine the degree of detail and the scope of coverage which the directory should encompass.

An appraisal of various data presentation techniques appropriate to OCD environmental data problems shows that virtually the only pertinent technique not currently in widespread usage is the large-scale map presentation of critical environmental data which is fundamental to engineering construction problems. Because of the likelihood of an eventual major shelter construction program, a recommendation is made for initiation of a pilot program for the preparation of engineering-geologic map folios for parts or all of three major cities in the United States. An example of this type of map folio is included in Appendix D.

Appendix A lists the environmental data categories selected as pertinent in this study, and their application to OCD problems. Appendix B consists of ten tabular summaries of the status of available data on the pertinent environmental data sources. Appendix C is an example of a directory of environmental data sources. Appendix E contains the research designs and cost estimates for the recommended directory of environmental data sources and the pilot program for the preparation of engineering-geologic map folios for selected urban areas.

ORGANIZATION AND PRESENTATION OF ENVIRONMENTAL DATA  
FOR OFFICE OF CIVIL DEFENSE USE

A Feasibility Study

PART I: INTRODUCTION

Objectives of Study

1. Many aspects of the programs carried out by Research and Technical Operations, Office of Civil Defense (OCD), require the use of various types of environmental information. In particular, problems related to fallout patterns, fire spread, thermal countermeasures, decontamination, post-attack water supply, evacuation, emergency communications, and the design, site selection, and construction of protective structures involve a wide range of environmental information in varying degrees of geographic coverage and detail.

2. Recognizing this need, the OCD requested that the U. S. Army Engineer Waterways Experiment Station (WES), Vicksburg, Mississippi, carry out a study which would evaluate the present status of existing environmental data and environmental data sources, and determine the feasibility of various methods of organizing and summarizing such existing information for OCD use. Specifically, the goals of this feasibility study were: (a) analysis of OCD environmental data requirements, (b) identification of environmental data sources and appraisal of data held by each, (c) evaluation of the availability and suitability of existing data for fulfillment of OCD requirements, and (d) recommendations as to the desirability and feasibility of various approaches to organization, summarization, and presentation of environmental data.

Scopes of Study and This Report

3. Personnel of the WES conducted a series of conferences with representatives of the OCD Research and Technical Operations staffs and various research project contractors of the OCD to determine the agencies'

requirements for environmental data. Specifically, it was desired to learn the nature of typical problems requiring such information, in particular the degree of detail needed, and how often these problems might be expected to arise. Part II summarizes this analysis of data requirements.

4. Before the various data sources were contacted, it was necessary to establish a comprehensive checklist delimiting the categories of environmental information pertinent to OCD needs. Such a list (discussed in Part III) was prepared by the WES, and after some modification and rearrangement resulting from discussion with OCD staff members and contractors, the list included the following major categories: terrain, vegetation, hydrology, and climate. These categories and their appropriate subdivisions served as the basis for the appraisal of the status of environmental data and data sources.

5. The nationwide appraisal of the status of environmental information (Part IV) consisted of first identifying the principal data sources for each category and subdivision (chiefly, the cognizant Federal agencies), and then, for representative organizations, conducting a census-like survey of the information held, specifically with respect to extent of coverage, degree of detail, percentage published versus unpublished, format of unpublished, and availability and suitability of unpublished data for OCD use.

6. After (a) OCD requirements had been analyzed, (b) the principal data sources located, (c) the status of environmental information held appraised, and (d) the suitability of existing data for fulfillment of OCD needs evaluated, the next step was to analyze the various means for obtaining, organizing, and presenting this information for actual use by the OCD. This analysis (presented in Part IV) indicated that there were two major items to be considered: (a) information systems, and (b) data presentation techniques.

7. Information systems are essentially broad, flexible structures or frameworks designed to facilitate the transfer of information from source to user. Three types of information systems were considered for use by the OCD; those based on (a) electronic data processing (i.e. automated) systems, (b) manned information centers, and (c) nonmanned, nonsynchronized systems. The application of each type of information system to the problem

of fulfilling the environmental data requirements of the OCD was ther evaluated in terms of suitability and cost.

8. Specific data presentation techniques, on the other hand, apply to the solution of precisely defined data problems. Such techniques include: (a) descriptive summaries, (b) handbooks, (c) bibliographies, (d) numerical data tabulations, and (e) various types of graphic presentation. Each technique was evaluated as to its application to the various categories of environmental data. Then, in order to illustrate such application, a series of conceptual problems was formulated, and appropriate presentation techniques were selected for each.

9. This report concludes with a series of recommendations for the establishment of an environmental data information system which would be appropriate to the OCD's requirements and available funds, and for utilization of particular data presentation techniques for selected aspects of their environmental requirements.

10. A series of appendices at the end of this report includes: summaries of data upon which the evaluations presented in the text are based, examples of an appropriate information system and of a special data presentation technique, and detailed research designs and cost estimates for the recommended courses of action.

## PART II: ANALYSIS OF OFFICE OF CIVIL DEFENSE REQUIREMENTS

11. The initial step in this feasibility study was an analysis of the environmental data requirements of the OCD. This analysis was carried out by means of conferences with Research and Technical Operations personnel of the OCD, a study of the work plans and project summaries for some 220 projects under Research and more than 100 projects under Technical Operations, and consultation and conferences with about 15 OCD research project contractors.

### Types of Requirements

12. In the course of the analysis, it became clear that the requirements of both the OCD and its contractors for environmental data fall into two major classes: (a) detailed specific information, and (b) authoritative generalizations of relatively broad scope. In addition, personnel of the OCD expressed the need for a system or method of listing data sources for various categories of environmental information. The two major classes are examined individually.

#### Detailed specific information

13. Requirements for highly detailed, specific information typically apply to a given topic or geographic area. A number of requirements for this type of information were developed during the exploratory conferences, such as: the range in soil temperatures for different parts of the United States, flow rates for various reaches of specific rivers, rates of tidal flushing and depth variation in estuaries, the typical range of Na and Mg content of bricks and cement for various cities and areas in the United States, and the depth of expected snow cover during specific months for given cities in the northern states.

14. As is apparent from these examples, the subject matter varies widely. Further, it seems improbable that a specific item of information will be needed on more than a relatively few occasions. In addition, the information will generally be needed on relatively short notice.

15. As will be shown subsequently in this report, enormous volumes of highly detailed environmental data currently exist. The bulk of the

data, however, is unpublished; it rests in the files of the various repository organizations across the United States. The principal problems in obtaining such data would be in locating the pertinent data source, and in setting up an efficient procedure for retrieving the desired information.

Authoritative generalizations

16. Requirements for authoritative generalizations of relatively broad scope tend to be more fundamental in character, and typically apply to a wider range of cases than do specific information requirements. Although these broader requirements were encountered only in a general way during the exploratory conferences with staff and contract personnel of the OCD, it seems probable that they will eventually develop for such topics as availability of shallow, potable groundwater for emergency water supply, probability of snow cover affecting decontamination procedures and extent of effect, methods for characterizing terrain units for use in computer solutions of fire-spread problems, air and ground temperature in relation to shelter ventilation and cooling, trafficability problems as limiting factor in evacuation potential, and the delimitation of areas characterized by such construction difficulties as severe foundation settlement, high groundwater table, probable slope failure, etc.

17. Here again, the subject matter varies widely, and the information will probably be needed on relatively short notice. In addition, even though a given generalization typically has broader application than an item of specific information and thus may be useful in a somewhat greater number of cases, its frequency of use will probably be low.

18. The preparation of authoritative, fundamental generalizations requires the efforts of highly experienced specialists in the pertinent scientific or technical field. Such generalizations are based on the specialist's experience and his familiarity with masses of detailed information. Generalizations of this type are difficult to prepare in advance because many of the factors to be considered cannot be supplied in advance. Here the problem lies chiefly in the rapid location of the specialist or authority with the needed experience and background at the time that the need arises.

19. The time required for developing information of this type varies considerably, depending on the nature of the problem and amount of

background information available. In some cases, the problem will be such that no valid generalization can be formulated without considerable additional basic or applied research. In such an instance, the decision that additional research is required is, in itself, an important generalization of considerable value to the OCD. With this information, the OCD can determine whether the problem warrants financing the appropriate research.

20. It should be noted that frequently the files of unpublished data pertinent to OCD needs for detailed specific information and the highly experienced specialist are housed in the same agency or organization. Further, rapid retrieval of the detailed information requested is often dependent upon the knowledge and experience of the specialist in charge of the information files. Similarly, the preparation of an authoritative generalization by a given specialist may require considerable use of the detailed data available in the files of the organization. Thus, although seemingly widely different in character, the two environmental information needs are in fact closely related.

Summary

21. Generalizations concerning the two classes of environmental data requirements are as follows:

- a. Both are highly variable as to subject matter, arise on relatively short notice, and require relatively rapid solution.
- b. Needs for a given item of detailed information are not likely to recur frequently, if at all.
- c. Needs for given authoritative, fundamental generalizations, although these generalizations apply to a larger number of individual cases than do detailed information, will also have a relatively low rate of recurrence.

Additional Considerations

22. Although OCD requirements can be more or less readily classed in two major types, the individual items within each type are not clearly defined at the present time. Further, because of the very nature of the many problems facing the OCD, it seems unlikely that more precise definition can be obtained in the near future. No relative rank, or order, of priority has been established by the OCD for the various environmental

data requirements listed in paragraphs 13 and 16, and there is no indication that such ranking is anticipated in the immediate future.

23. Although a definite need exists for detailed specific information such as that cited in paragraph 13, the importance of the information is not great enough to warrant a major effort on any given item or problem. The same holds true for the authoritative generalizations described in paragraph 16. On the other hand, it appears that a broad, flexible, relatively inexpensive organizational framework of information, within which appropriate emphasis can be given to the various types of specific problems as they arise, is warranted. This is in line with requests by OCD personnel for an approach that will cover as broad a spectrum of environmental data problems as possible with the funds available.

24. In light of the foregoing considerations, it appears that the first step in fulfilling OCD environmental data requirements should be the development of a relatively broad, flexible, and inexpensive information system. Subsequently, as individual environmental data problems become more clearly defined and priorities are assigned by the OCD, specific techniques for their solution can be developed. Development of such techniques could be carried out as an integral part of the basic information system.

## PART III: CATEGORIES OF ENVIRONMENTAL DATA

Major Categories

25. To appraise the current national status of environmental information, it was first necessary to determine the various categories of data to be considered. Study indicated that the broad topics probably most pertinent to the needs of the OCD are: terrain, vegetation, hydrology, climate, and radio propagation. Personnel of the WFS, working in cooperation with the OCD, compiled a list of 13 major categories based on these topics. This list, which provides the basic framework for the status appraisal, includes: terrain configuration, soils, bedrock, geologic phenomena, vegetation, groundwater, surface water, temperature, radiation, precipitation, winds, background radiation, and radio propagation and electromagnetic phenomena.

Category Subdivisions

26. Each of the above-listed categories may be further subdivided. In this way various aspects of the major categories can be considered. For example, subcategories within soils include: soil type (engineering and pedologic classification), chemical and mineralogical composition, physical properties, distributional data (thickness, areal extent), construction characteristics, and trafficability characteristics. These subcategories can be further subdivided; however, such subdivision is not only unnecessary for the purpose of this study, but also quickly reaches the point of diminishing returns in that some of the subdivisions are in fact derived from or based on other, more fundamental properties. For example, in the case of physical properties of soils, thermal properties are a function of composition, density, and moisture content. For these reasons, considerable time and effort were spent in arriving at a basic appraisal checklist which contained a realistic, yet workable, degree of detail. This list stresses the fundamental rather than the derived categories. It is an extension and subdivision of the framework listed in paragraph 25, and is presented in full as Appendix A.

Category Applications

27. Applications of the specific data categories to the mission and problems of the OCD are cited in detail in Appendix A. A summary of these applications is presented in table 1.

Table 1  
Application of Environmental Data to OCC Problems

PART IV: APPRAISAL OF STATUS AND SUITABILITY  
OF EXISTING ENVIRONMENTAL DATA

28. To evaluate the various possible means for fulfilling OCD environmental data requirements, it was necessary first to appraise the current national status of environmental data, and second, to determine in what degree the existing data are suitable for OCD usage.

Appraisal of Status

Procedure and criteria

29. An appraisal of the status of existing environmental data held by the various cognizant Federal and state offices and agencies was carried out by WES personnel in the following manner. A list of pertinent agencies and organizations was compiled for each data category. Within each category the agencies and organizations were ranked as to probable importance as data sources. In most cases, visits were made to the three or four top-ranking sources. Each visit generally consisted of one or more interview-conferences in which the following aspects of the given data source were considered:

- a. Organizational structure of agency.
- b. Principal topic or geographic area of interest, or both.
- c. Area of coverage.
- d. Degree of detail.
- e. Percentage of data published versus unpublished.
- f. Typical format of unpublished data.
- g. Availability of unpublished data, including where filed.

30. This information was recorded on a separate work sheet for each agency. After a preliminary study, the data were reduced to one overall status sheet for each category; the sheet contained a list of the sources contacted and a summarized appraisal of each source. The "category status sheets" (which comprise Appendix B) constitute the fundamental documents in the nationwide appraisal of the status of existing environmental data.

31. For conciseness of presentation, the voluminous, detailed information contained in Appendix B has been condensed to one overall

appraisal of status, which is presented in table 2. In this table, the status of environmental data for each category has been summarized under six headings. These headings are essentially the same as the topics covered in the original source interviews described in paragraph 29. Thus, the significant facts from more than 45 interviews are summarized in table 2.

Quality of sampling

32. In all, some 31 offices or branches of 14 major Federal agencies were contacted, along with five state organizations, five university departments, and five private research groups. Although the census was certainly not all-inclusive, the national-level organizations visited constitute close to 75 percent of the pertinent national data sources, and hold the bulk of the environmental data in most of the fields related to the present study. For this reason, it is believed that the data collected in this study represent a valid sampling of the national status of the data in each category. Although only a relatively small percentage of the possible state-level agencies was contacted, the sampling is considered to be representative of the type, general scope, and degree of detail of the information held by such sources across the nation. Also, it should be noted that an exhaustive appraisal of the status of environmental data was beyond the scope of this study.

Evaluation

33. The evaluation of the material presented in table 2 and in the more detailed status sheets upon which table 2 is based (see Appendix B) indicates that voluminous detailed information generally exists for virtually all aspects of the 13 categories listed, but that the bulk of the data is unpublished, and is held in files of the cognizant agencies. The format and degree of processing of these file data vary widely. In addition, file data generally are held at the local, state, or regional office level. Nationwide centralization exists only for weather records and a few highly selected aspects of other categories.

34. Although virtually all Federal and most state data files theoretically are available to the OCD, the practical difficulties involved in obtaining information from the files of the repository agency seriously limit the accessibility of most information. It should be emphasized that

Variable	Description	Range	Units	Source	Notes
Latitude	Air temperature, precipitation, and snowfall patterns are influenced by the angle of the Earth's axis relative to the Sun. The angle of the axis is constant, but the position of the axis varies over time.	-90° to 90°	degrees	USGS	Latitude is a key factor in determining climate. It is used to calculate the angle of the Sun's rays at different times of the year, which affects the amount of solar energy received by the Earth.
Longitude	Air temperature, precipitation, and snowfall patterns are influenced by the angle of the Earth's axis relative to the Sun. The angle of the axis is constant, but the position of the axis varies over time.	-180° to 180°	degrees	USGS	Longitude is used to calculate the angle of the Sun's rays at different times of the year, which affects the amount of solar energy received by the Earth.
Altitude	Air temperature, precipitation, and snowfall patterns are influenced by the angle of the Earth's axis relative to the Sun. The angle of the axis is constant, but the position of the axis varies over time.	0 to 10,000 meters	meters	USGS	Altitude is used to calculate the angle of the Sun's rays at different times of the year, which affects the amount of solar energy received by the Earth.
Relative humidity	Air temperature, precipitation, and snowfall patterns are influenced by the angle of the Earth's axis relative to the Sun. The angle of the axis is constant, but the position of the axis varies over time.	0% to 100%	%	USGS	Relative humidity is used to calculate the angle of the Sun's rays at different times of the year, which affects the amount of solar energy received by the Earth.
Insolation	Air temperature, precipitation, and snowfall patterns are influenced by the angle of the Earth's axis relative to the Sun. The angle of the axis is constant, but the position of the axis varies over time.	0 to 1000 W/m²	W/m²	USGS	Insolation is used to calculate the angle of the Sun's rays at different times of the year, which affects the amount of solar energy received by the Earth.
Groundwater	Air temperature, precipitation, and snowfall patterns are influenced by the angle of the Earth's axis relative to the Sun. The angle of the axis is constant, but the position of the axis varies over time.	0 to 1000 m³/d	m³/d	USGS	Groundwater is used to calculate the angle of the Sun's rays at different times of the year, which affects the amount of solar energy received by the Earth.
Surface water	Air temperature, precipitation, and snowfall patterns are influenced by the angle of the Earth's axis relative to the Sun. The angle of the axis is constant, but the position of the axis varies over time.	0 to 1000 m³/d	m³/d	USGS	Surface water is used to calculate the angle of the Sun's rays at different times of the year, which affects the amount of solar energy received by the Earth.
Temperature	Air temperature, precipitation, and snowfall patterns are influenced by the angle of the Earth's axis relative to the Sun. The angle of the axis is constant, but the position of the axis varies over time.	-50°C to 50°C	°C	USGS	Temperature is used to calculate the angle of the Sun's rays at different times of the year, which affects the amount of solar energy received by the Earth.
Precipitation	Air temperature, precipitation, and snowfall patterns are influenced by the angle of the Earth's axis relative to the Sun. The angle of the axis is constant, but the position of the axis varies over time.	0 to 1000 mm/d	mm/d	USGS	Precipitation is used to calculate the angle of the Sun's rays at different times of the year, which affects the amount of solar energy received by the Earth.
Wind	Air temperature, precipitation, and snowfall patterns are influenced by the angle of the Earth's axis relative to the Sun. The angle of the axis is constant, but the position of the axis varies over time.	0 to 1000 m/s	m/s	USGS	Wind is used to calculate the angle of the Sun's rays at different times of the year, which affects the amount of solar energy received by the Earth.
Biosphere	Air temperature, precipitation, and snowfall patterns are influenced by the angle of the Earth's axis relative to the Sun. The angle of the axis is constant, but the position of the axis varies over time.	0 to 1000 m²	m²	USGS	Biosphere is used to calculate the angle of the Sun's rays at different times of the year, which affects the amount of solar energy received by the Earth.
National Bureau of Standards	Air temperature, precipitation, and snowfall patterns are influenced by the angle of the Earth's axis relative to the Sun. The angle of the axis is constant, but the position of the axis varies over time.	0 to 1000 m²	m²	USGS	National Bureau of Standards is used to calculate the angle of the Sun's rays at different times of the year, which affects the amount of solar energy received by the Earth.
Radio frequency	Air temperature, precipitation, and snowfall patterns are influenced by the angle of the Earth's axis relative to the Sun. The angle of the axis is constant, but the position of the axis varies over time.	0 to 1000 m²	m²	USGS	Radio frequency is used to calculate the angle of the Sun's rays at different times of the year, which affects the amount of solar energy received by the Earth.

no significant deficiencies at the category level were found in the status of environmental information. No statements can be made concerning the existence of possible deficiencies at the subcategory level, inasmuch as the scope of this study did not permit sampling in sufficient detail to locate possible deficiencies at that level.

Appraisal of Suitability

35. The suitability for use by the OCD of a given type of environmental data in its existing format and state of processing is determined by the nature of the specific data problem at hand. Data in a given format and degree of detail might be suitable for one problem and unusable for another. The question of suitability can be answered only after a specific problem has been precisely defined, and the type of environmental data held by the principal data sources determined. In short, no general statement as to suitability can be formulated in advance; each case must be appraised separately as it arises.

## PART V: INFORMATION SYSTEMS AND DATA PRESENTATION TECHNIQUES

General

36. Because requirements of the OCD for specific information cover an extremely wide range of topics, because a given item or type of information may be of value only on a single occasion or in a single set of circumstances, and because the needed format and degree of detail are generally difficult or impossible to visualize in advance, advance processing or preparation of environmental data for possible use by the OCD does not seem feasible, except in certain instances.

37. The problem, in short, is one of increasing the accessibility and usability of existing data, rather than collecting or processing additional basic data. This is true for both the highly detailed environmental information and the authoritative fundamental generalizations required by the OCD. The problem centers around how to facilitate the transfer of information from the pertinent data source or authority to the OCD. This appears to be basically a question of how to improve communication between user and source.

38. As stated in paragraph 24, development of a general information system appears to be the first step in fulfilling the OCD's environmental data requirements. The next step would be application of specific data presentation techniques to individual problems as they arise.

Information Systems

39. An information system is a broad framework or organizational structure established to facilitate the transfer of needed information from source to user. It may be as elaborate as the U. S. Information Agency, or as simple as the information operator for a telephone system. It may involve a number of personnel, or it may be as inanimate as an IEM computer, a stack of punch cards, or a telephone directory. Obviously, the order of magnitude and the cost of the system are dependent on the job to be done and the funds available.

40. In the course of this study, the application of several types of

information systems to the requirements of the OCD was examined. The types of information systems which were considered include: (a) a system which would utilize one or more of the currently existing information systems, (b) a system which would link together the various existing data centers, (c) a system focused on a small OCD in-house information center, and (d) a system utilizing one or more nonmanned, nonautomated data bases. Each type of system is considered individually in the following paragraphs, and is appraised in summary form in table 3.

Existing information systems

41. An OCD environmental information system could be set up so as to operate within the framework of an existing information system. At least six elaborate systems are currently in operation within various branches of the Federal government. These are: (a) Department of Defense Damage Assessment Center (DODDAC), (b) Office of Emergency Planning National Resources Evaluation Center (NREC), (c) Smithsonian Institution Scientific Information Exchange (SIE), (d) Armed Services Technical Information Agency (ASTIA), (e) Atomic Energy Commission Technical Information Service (TIS), and (f) Advanced Research Projects Agency VELA Uniform Seismic Information Center (VESIAC). Although most of the systems cited utilize machine data processing, storage, and recall, they vary widely as to goals, approach, equipment, capacity, and cost of operation.

Existing data centers

42. Another possibility would be the establishment of an OCD information system designed to operate primarily by linking together the various existing data centers that cover selected aspects of environmental information. These existing data centers include: National Weather Records Center, National Oceanographic Data Center, Infra-red Information Center, a VELA Uniform Seismic Information Center, and several Glaciological Data Centers. In addition, a National Geodetic and Geomagnetic Data Center has been formally proposed, and a National Geologic Data Center is currently under study. An information system encompassing such centers would be quite elaborate, and would require extensive interagency cooperation.

OCD in-house information center

43. An environmental information system could also be built around a relatively small information center within the OCD. The in-house center

would consist of an experienced professional scientist and adequate supporting secretarial personnel. The scientist's primary responsibility would be the coordination of the environmental information system of the OCD. The coordinator and the system would serve the needs of both the Research and Technical Operations staffs of the OCD. Possible utilization of available electronic data processing capabilities is envisioned.

Nonmanned, nonautomated data base

44. An environmental information system utilizing one or more nonmanned, nonautomated data bases would be relatively simple and inexpensive to set up and use, but flexibility, capacity, and the product are proportionately more limited. Such a system could be based on a directory of environmental data sources, or on one or more reference libraries.

Evaluation of proposed systems

45. The detailed study of the appraisals summarized in table 3 has led to the following generalizations. In the case of an information system for the OCD which would utilize the facilities of one of the currently existing information systems, it seems evident that the present facilities are already either fully committed or nearly so, and that the present organizational structure of the existing systems, with the possible exception of NREC, is not particularly suited to the requirements of the OCD. The data base presently used by DODDAC and NREC also appears to be inappropriate for environmental data use by the OCD. Until the OCD's specific data needs are more precisely defined, several of the existing systems are too complex for practical use by the OCD. Further, the cost of adding the necessary voluminous environmental data to an existing system would be high, and as the scope of stored data broadens, the possibility of significant unnecessary overlap with other systems would materially increase. In short, the establishment of an information system for the OCD utilizing the facilities of one of the existing information systems is not a feasible solution to the environmental data requirements of the OCD.

46. In the case of an information system for the OCD which would link together existing data centers, each center currently in operation has clearly defined goals and responsibilities. It is doubtful that any given center could readily assume the additional organizational and administrative responsibilities attendant upon establishment of an information system for

**Table I**  
**Summary Appraisal of Existing and Proposed Information Systems and Data Centers**

System or Center	Current Status	Availability for OOD use	Type and nature of data held or information coverage	Cost	Comments
<b>Existing Information Systems</b>					
VISDAC	Functioning	Not available	Military usage requirements not pertinent to environmental data problems	Not applicable	
NOFC	Functioning	Limited availability of computer time	Precise data base not pertinent to environmental data problems	High	Would have to punch the pertinent environmental information into storage at great cost
CIOF	Functioning	Product available, but not to in-situ systems	Summary of unclassified research, financial requests, projects at time of initiation or published date	None	Unpublished computer system; valuable source of environmental data for OOD
ATIA	Functioning	Product available, but not to in-situ systems	Summary of facilities/demands for research, data, published and unpublished	Low to none	Relatively elementary data storage and processing system
TSI	Functioning	Product available, but not to basic systems	Central information source and index for unclassified publications, data sets, etc. At odds between TSI and CIOF	None	Selected aspects of information should be of great value to OOD; most information, however, not related to OOD applications
WDC-DAC	Not functioning	Product available, but not to in-situ systems	Unclassified and partially declassified information and technology, data sets, reports, and bibliographies, data related to sensitive, classified, and dual-use operations	None	Supplies reference material, bibliographic data, and published material on specified subject; obvious restricted subject matter limits value to OOD
<b>Proposed Information Systems</b>					
National Weather Service Center	Productive	Product available, but neither nor currently prepared to incorporate significant environmental responsibilities related to OOD information systems	National archives of precipitation, relatively low level and environmental data	Relatively low to none	Subject matter of data held at this center closely related to many OOD environmental problems
National Oceanic and Atmospheric Data Center	Functioning	Product available, but center not currently prepared to incorporate significant environmental responsibilities related to OOD information systems	Will have national archival responsibility for oceanographic and related data	Relatively low to none	Center just getting under way; operations presently limited; only selected aspects of the data held are pertinent to OOD
NOFAC	Productive		See VISDAC appraisal presented in section above on existing information systems		
Geodetic and World Data Centers	Functioning	Product available as above in VISDAC	Archival responsibility for selected aspects of OOD geodeticologic data	Relatively low to none	Data generally have little pertinence to OOD environmental problems
Infrared Information Center	Functioning	Unclassified product available; availability of classified product limited	Mostly aspects of infrared research which coverage probably international	Low to none	Data held directly related to narrow range of OOD problems
National Geodetic and Geomagnetic Data Center	Possibly to be created	Presumably product will be available	Will have national archival responsibility for geodetic and geomagnetic data	Presumably low to none	This center has been formally proposed
National Geological Data Center	Possibly to be created	Presumably product will be available	Probably will have national archival responsibility for selected types of geological data	Presumably low to none	This center is under study, but has not yet been formally proposed
Small OOD In-House Information Center	To be created	Would operate solely for OOD use	To be determined, but probably limited in-house storage with emphasis on maximum utilization of information from cognizant agencies and data centers	Relatively low, generally function of scope of program	Information center would probably consist of one professional scientist who would coordinate OOD environmental data needs, and would be the focal point of Technical Operations of OOD. The center would serve as a communication channel between in-house users and various other agencies and organizations which are the data sources
<b>OOD Recommended Recommended Data Base</b>					
Directory of data sources	To be created	Would operate solely for OOD use	Could be designed to cover all pertinent environmental fields	Moderate cost to establish; moderate cost to update every few years	Would include state and Federal agencies, universities, private organizations, existing data centers, and pertinent individual authorities
Reference library	Functioning (in part)	ODC library recently combined with Army library	Replete on bibliographic services	Low	Relatively slow method; available principally to in-house personnel; field offices and contractors have limited access only

the OCD. Also, existing centers cover relatively few scientific fields of direct concern to problems of the OCD. The cost of setting up additional information centers in the various pertinent scientific fields to provide thorough coverage for the OCD would be enormous. Such a system would also involve considerable interagency cooperation, and would require an appreciable period of time to establish. Accordingly, this type of information system for the OCD does not appear feasible at the present time.

47. An information system for the OCD built around a small in-house coordinator and information center would afford an effective and relatively inexpensive means for fulfilling environmental information requirements of the OCD. The professional scientist who would head the center as Staff Coordinator for Environmental Data should have not only a broad background in pertinent scientific fields, but also a high degree of awareness of typical problems and data requirements of the OCD as well. Although not elaborate, a center consisting of a coordinator and supporting personnel would offer a high degree of flexibility as well as a moderate speed of operation. Therefore, an information system focused on an in-house coordinator and information center would constitute an effective means of providing the needed environmental data at a reasonable cost.

48. In the case of an information system for the OCD utilizing one or more types of a nonmanned, nonautomated data base, a detailed directory of environmental data sources subdivided by category and cross-referenced by geographic area would provide a moderate-cost data base for a workable information system. Utilizing such a directory, the staff or contract personnel of the OCD could quickly determine the principal data sources for a given topic as well as the type, approximate extent of coverage, and degree of detail of the information held by each source. Subsequent direct contact with the pertinent data source (agency or specialist) would then produce the best available information on the question at hand. Such a directory would have the following advantages: (a) the directory framework could be highly flexible; (b) the degree of detail contained could vary as desired; (c) it would be suitable for use by the Research and Technical Operations staffs, contractors, and local field offices of the OCD; and (d) it would be only moderately expensive.

49. A reference library is another type of nonautomated data base.

An information system for the OCD utilizing such a data base would constitute probably the simplest and most limited framework which can be considered an information system. In such a framework (as in the case of the directory described in paragraph 48), various components of the information system would be informal, i.e. the users would work directly with the sources, and there would be virtually no intermediate steps except perhaps the work of a reference librarian who would direct the user to the pertinent reference source. In such a situation (and this also holds true for the directory), the user would realize a profit generally in direct proportion to the effort which he expended on the system. Although perhaps not formally defined as such, the reference library-based information system currently exists in the OCD. Because much of the environmental data which is needed by the OCD is relatively inaccessible, unpublished file material, it seems clear that an information system based solely on a standard reference library of published works is not an adequate solution to environmental data requirements of the OCD.

#### Data Presentation Techniques

50. As individual data problems become more precisely defined through the established information system, specific carefully designed data presentation techniques should be worked out to solve them. Accordingly, the application of various types of data presentation techniques to the environmental information problems of the OCD was considered in this study.

#### Techniques considered

51. The various data presentation techniques which were considered include general descriptive summaries, handbooks, bibliographies, tabulations of numerical data, and various types of graphic summaries, including maps. The applicability of any given data presentation technique depends, of course, upon the nature of the information problem at hand.

52. The terms used in this study for the various techniques are defined as follows:

- a. General descriptive summary refers to a comprehensive and authoritative treatment of a given problem or series of

problems by a recognized expert. Theoretical concepts would be treated thoroughly. The scope of the summary might range from a concise treatment of a restricted problem to a monographic coverage of a major research project. An example might be a descriptive summary of some aspect of heat flow through various types of earth materials.

- b. Handbook is considered here to be a compilation of useful factual data, generally presented in a ready-to-use form. Stress would be on practical applications. The preparation of a handbook requires direction by highly trained specialists in the fields covered. Such a technique would be valuable in presenting to engineering firms and construction companies the effects of environmental conditions on the cost of shelter construction.
- c. Bibliography is used in the standard sense. The preparation of a bibliography would require the work of trained specialists in the pertinent technical field.
- d. Tabulations of numerical data may be prepared either manually or by machine for use in solution of a variety of problems. Such tabulations can be prepared only if problem requirements have been defined precisely. Examples of problems utilizing such tabulations include point-to-point rate of flow for a given river system. Problems related to climatic parameters also normally require tabular data.
- e. Graphic summaries include graphs, cross sections, diagrams, charts, and maps. Selection of the specific type to be used depends on such factors as purpose, degree of detail desired, and type and quantity of basic data available. Several categories of environmental information lend themselves to graphic summarization; for example, summarized climatic data are commonly presented on graphs and maps. Some hydrologic data follow similar patterns. The effects of soil, bedrock, and water-table conditions on shelter construction can best be shown on maps.

#### Application to environmental data categories

53. As a means of appraising the applicability of the various data presentation techniques, individual techniques were considered for each major category of environmental data. This evaluation is summarized in table 4.

54. A brief study of table 4 shows that each of the five types of data presentation techniques applies to some aspect of almost every category of environmental information. Thus, when a given problem is clearly defined, the user can work cooperatively with the pertinent data source or

Table 4  
Appraisal of Data Presentation Techniques

Categories	Application of Techniques				
	(A) Description	(B) Tabular	(C) Monographs	(D) Numerical Tabulations	
Terrain configuration	Insight analysis of effect of terrain configuration on plant overpressure	Presentation of site data for shelter location and construction	Support of research, and of preparation of other presentation methods	Terrain unit squares and its size, aspect ratio, profile, slope angle, and elevation, earth material	Applies to A, B, and D of this category, i.e., (A) presentation of site data for site selection and construction; (B) illustration of basic material; (C) curves, graphs, and maps summarizing distribution of quantitative data
Solids	Analysis of soil effects on the site, i.e., bearing, and soil resistance effects on shelter resistance to fallout	Presentation of soil data for site location and construction	Support of research, and of preparation of other presentation methods	Chemical composition, including mineral composition	Applies to presentation of thickness, composition, and engineering effects of soils; also to (A) in part, and to (B)
Bedrock	Analysis of effects of bedrock on the site, i.e., depth, and failure of shelter	Presentation of bedrock data for site location and construction	Support of research, and of preparation of other presentation methods	Variation in chemical and mineral composition	Applies to presentation of depth, composition, and engineering effects of bedrock, and in part to (D)
Seismic potential	Analysis of seismic potential, i.e., magnitude, and seismic hazard index	Presentation of seismic data for site location and construction	Support of research, and of preparation of other presentation methods	Intensity of seismic waves as function of distance from epicenter, maximum rate along scale for given earth material	Applies to presentation of areal distribution of seismic data and of seismic potential
Vegetation	Analysis of effects of vegetation, i.e., impact of plant species	Not applicable	Support of research, and of preparation of monographic and other summaries	Vegetation unit squares used in fire-spread computer programs; density of crop coverage in agricultural areas	Applies to presentation of statistical data as curves and graphs for (A); map presentation shows areal distribution of quantitative data
Hydrology	Analysis of effects of water availability, i.e., rainfall, snowmelt, and ground water supply	Presentation of hydrologic effects, i.e., rainfall, snowmelt, and presentation of data on emergency water supply	Support of research, and of preparation of monographic and other summaries	Volume of groundwater variation in temperature, pressure, and chemical composition; groundwater hardware information	Applies to presentation of areal distribution of depth to water table, variation in temperature, pressure, and chemical composition of groundwater and effect on shelter design, site location, and construction; emergency water supply for drinking and cooking, water for cooling shelters and shelter backbone
Surface water	Analysis of surface-water effects, i.e., flow, shelter, the relationship of precipitation to availability of surface water	Presentation of surface-water effects, i.e., flow, shelter, the relationship of precipitation to availability of surface water	Support of research, and of preparation of monographic and other summaries	Discharge volumes, flow rates, temperature, chemical composition, point-to-point travel time, major rivers	Applies to presentation of areal distribution of data in (D), and areal distribution of limits of surface flooding
Temperature	Analysis of temperature effects in regard to selected problems of CO	Presentation of temperature effects, i.e., shelter selection and construction, and presentation of data on emergency water supply; emphasis on minimum temperatures, air temperature, and 8° air temperature	Support of research, and of preparation of monographic and other summaries	As prepared and published by the U. S. Weather Bureau, selected aspects of weather data, and data pertinent to CO problems could be emphasized in additional tabulation	Applies to graphic presentation of statistical data; some emphasis on map presentation of areal distribution and variation of values
Solar radiation	Analysis of effects of solar radiation on shelter design and maintenance	Possibly in presentation of solar heat loss for architectural use in shelter design	Support of research, and of preparation of monographic and other summaries	Planting technique, together with curves or bar graphs, for analysis and presentation of most atmospheric data	-
Precipitation	Analysis of effects and implications of precipitation in regard to selected CO problems	Condensed treatment for effects of precipitation on decontamination techniques	Support of research, and of preparation of monographic and other summaries	Numerical tabulations are standard technique	Standard technique, together with curves or bar graphs, for analysis and presentation of most precipitation data; maps are also extremely useful here
Winds	Analysis of effects and implications of winds in regard to selected CO problems	Condensed treatment for effects of wind on decontamination techniques	Support of research, and of preparation of monographic and other summaries	Numerical tabulations are standard technique	Standard technique, together with curves or bar graphs, for analysis and presentation of most wind data; maps are also useful here
Background radiation count	Analysis of areal variation of total natural background radiation as a reference for comparison of artificial radiation	Not applicable	Support of research, and of preparation of monographic and other summaries	Numerical tabulations are standard technique	Maps are particularly useful for showing areal variation
Radio propagation and electromagnetic phenomena	Analysis of effects of nuclear detonation on radio propagation and electromagnetics	Practical for presentation of applied information related to radio communications, i.e., favorable and unfavorable channels for given areas	Support of research, and of preparation of monographic and other summaries	Numerical tabulations and series of curves are standard technique, maps are particularly useful for showing areal variation	-

authority to select the most suitable data presentation technique for the problem at hand.

Conceptual problems

55. To appraise further the various data presentation techniques, WES personnel developed a number of conceptual problems, and attempted to select the most suitable presentation technique or combination of techniques for each. A list of such problems along with suggested techniques is as follows:

- a. Problem: Effects of environment on shelter site location and construction. Suggested data presentation technique: Prepare special maps interpreting restrictive effects of critical environmental conditions on shelter construction in major urban areas.
- b. Problem: Effects of environment on cost of shelter construction. Suggested technique: Prepare a series of regional descriptive summaries treating the problem; use curves, tables, and graphs to accompany the text. Condensed results might well be presented in handbook form.
- c. Problem: Probable soil temperature variations with depth and season by regions. Suggested technique: Prepare maps of interpreted data accompanied by a brief descriptive text. Considerable bibliographic work and possible basic research might be required to obtain the needed data.
- d. Problem: Estimated point-to-point rates of flow of major rivers of the United States. Suggested technique: Prepare descriptive text and a series of curves derived from tabular numerical summaries based on computer analysis of machine-stored data.
- e. Problem: Predicted periodicity of freezing and thawing for pertinent United States cities. Suggested technique: Use tabular numerical summaries based on computer analysis of machine-stored data. The results of the analysis would probably best be presented in a descriptive text supported by maps and numerical tables.
- f. Problem: Periodicity, intensity, and duration of climatic conditions affecting active thermal countermeasures. Suggested technique: Prepare a descriptive summary based on extensive computer analysis of machine-stored data. The text should probably utilize extensive curves, tables, and maps to present results.
- g. Problem: Prediction of the most suitable post-attack radio frequencies and their probable variation in performance with time after detonation. Suggested technique: Prepare descriptive summaries supported by curves and tables. Condensed results might also be presented advantageously in handbook form.

Evaluation

56. An appraisal of the status of current usage of each major type of data presentation technique indicates that descriptive summaries, handbooks, bibliographic compilations, and various types of numerical tabulations and graphic summaries are in wide use. However, the map presentation of critical types of environmental data which are fundamental to engineering construction problems (paragraph 55a) is not in general use, and it is believed that this moderately specialized technique may prove very useful in connection with the environmental data problems of the OCD concerning fallout shelter construction in large urban areas.

## PART VI: CONCLUSIONS AND RECOMMENDATIONS

Conclusions

57. Voluminous unpublished data in various stages of processing exist for all pertinent categories of environmental information; the data are generally filed in local, state, or regional offices, and the practical difficulties in obtaining such information are significant. For various reasons, advance processing or preparation of environmental data for possible use by the OCD is not feasible, except in certain selected cases. Emphasis should be on increasing the accessibility and usability of existing data rather than on the collection or processing of additional basic data.

58. It seems clear that adequate fulfillment of the environmental data requirements of the OCD centers around establishing an effective organizational structure which will facilitate communication and transfer of information from the data sources to the user, i.e. establishment of a moderately well-defined, yet relatively inexpensive, information system. Information systems which appear to be feasible for use by the OCD include: (a) a system based on an in-house information center headed by a staff coordinator for environmental information, and (b) a system utilizing some type of nonmanned, nonautomated data base such as a directory of environmental data sources.

59. As individual data problems become more clearly defined through the functioning of the information system, carefully selected data presentation techniques can be worked out to solve them. Virtually the only data presentation technique which is pertinent to the problems of the OCD and not currently in wide use is the large-scale map presentation of critical environmental data which is fundamental to engineering construction problems.

Recommendations for Information System

60. Based on the conclusions just outlined, it is recommended that the OCD set up the following three-part information system in a series of

three steps. The recommended system would consist of: (a) an OCD Staff Coordinator for Environmental Data who would be a professional earth scientist, (b) a Board of Expert Advisers representing pertinent environmental disciplines, and (c) a directory of Federal, state, municipal, and private environmental data sources.

61. The selection and appointment of the staff coordinator (step one) and the board of advisers (step two) should be carried out as soon as practical. The preparation of the data source directory (step three) would follow steps one and two after a six-month to one-year period during which time the staff coordinator could determine the degree of detail and the scope of coverage which the directory should encompass.

Staff coordinator:

62. The OCD Staff Coordinator for Environmental Data and a small secretarial and clerical staff would comprise a small but effective environmental information center within the OCD. This center would serve as the nucleus or keystone for the information system.

63. The coordinator should have as broad an experience background in earth sciences as possible. His chief function would be to coordinate and expedite the transfer of environmental data from the various source agencies to the users (in-house staff and contract personnel of the OCD). Wherever appropriate, he would endeavor to place the user in direct communication with the pertinent data source. In addition, it would be his responsibility to determine, in a six-month to one-year period, the scope, extent of coverage, and degree of detail which would be desirable in the data source directory. He would then recommend to the OCD the preparation of this directory at the appropriate time.

Board of advisers

64. A board of advisers representing the pertinent physical environmental sciences would provide a source of highly competent opinion on environmental data problems available to the staff coordinator, and to the in-house and contract personnel of the OCD when appropriate. Such a board should probably consist of ten to twelve professional scientists, and should include individuals representing as many as possible of the following disciplinary backgrounds:

<u>Earth Sciences</u>	<u>Atmospheric Sciences</u>	<u>Hydrospheric Sciences</u>
Engineering Geology	Climatology	Hydrology
Soil Mechanics	Meteorology	Estuarine Oceanography
Pedology	Atmospheric Physics	Estuarine Ecology
Groundwater Geology		
Geomorphology		
Seismology		

65. To insure maximum effectiveness, the selection of the advisory board should be made by a person or persons familiar with both the scientific fields involved and the range of the environmental data requirements of the OCD. Where necessary, the assistance of the appropriate national professional societies could be utilized. It is respectfully submitted that the individuals who carried out the study reported herein, because of their familiarity with the needs of the OCD and with the pertinent sciences, would be the logical persons to select the advisory board.

Directory of environmental data sources

66. A detailed directory of environmental data sources, subdivided by category, and cross-referenced by topic, geographic area, and source agency, would provide a valuable supplementary element in the recommended information system. Such a directory, which could be prepared under contract, would include a comprehensive listing of virtually all Federal and state agency environmental data sources, as well as most of the appropriate private organizations. Its principal purpose would be to serve as a supplement and support to the work of the staff coordinator in facilitating contact between personnel of the OCD and various source agencies or individual authorities. The directory would be useful at several levels within the OCD, i.e. by Research and Technical Operations staffs, by research project contractors, and by personnel in state and local offices of the OCD. Such a directory would serve in a coordinator-like fashion. Obviously, it would not be as flexible, and thus not as helpful, as the staff coordinator, but through wide distribution, it could perform its substitute "coordinator" function at a variety of places concurrently. Consequently, only the more critical problems would be brought to the staff coordinator, and his work load would remain within reason.

67. The determination of the appropriate degree of hierarchical

breakdown required for a workable directory is probably the most critical step in its planning and preparation, because cost is a direct function of the degree of subdivision. This decision should be arrived at jointly by the staff coordinator and the responsible contractor.

68. It should be noted that concurrently with compilation of the basic information for the production of the directory, much of the same information could be added to IBM punch cards at little additional cost. The punch card deck could be used for machine sorting and retrieval with the IBM equipment currently available to the Technical Operations staff of the OCD. The punch card deck could also be used for periodic updating and revision of the distributed copies of the directory.

69. An example of a detailed directory of environmental data sources is included as Appendix C. In addition, a complete research design for producing such a directory, along with cost estimates, is presented in Appendix E.

#### Mode of operation

70. These recommendations should serve to establish an effective information system for solving various individual environmental data problems as they arise. It is envisioned that the recommended system would function in approximately the following manner:

- a. The in-house staff and contract personnel of the OCD would discuss their respective environmental data problems with the staff coordinator.
- b. The coordinator would then suggest the appropriate source for the data required (for example: published texts, monographs, tables, maps, etc., when such are known to him). If little or no published information exists, then the coordinator would suggest the appropriate source agency or individual authority to be consulted.
- c. The staff or contract personnel would then consult the published or unpublished source or sources suggested by the staff coordinator.
- d. When the problem warrants, the staff coordinator would seek advice from the board of expert advisers on where the needed information or professional opinions might be obtained. This information would then be communicated to the user who would in turn contact the source directly.
- e. When the work load of the staff coordinator (i.e. the number of requests for assistance) so warrants, step three (preparation, printing, and distribution of the data source

directory) should be carried out under contract. The use of : of the directory would supplement the work of the staff coordinator as outlined in paragraph 66.

Adequate utilization of this information system should allow rapid location of the appropriate data source and subsequent transfer of data from source to user.

Recommendations for Data Presentation Techniques

71. The OCD specifically requested that wherever possible in this feasibility study, attempts be made to project the planning and probable needs of the OCD for at least five years, and that recommendations be based on this long-range view. In this regard, the probability seems great that a large-scale shelter construction program will eventually be carried out, even though such a program is not currently under way. Any such construction program would require extensive detailed data on the effects of environmental conditions on shelter site selection and construction. It is believed that the most practical and, in the long run, the most inexpensive way of presenting such data is by means of large-scale specialized maps of the type described in Appendix D.

72. Accordingly, it is recommended that a pilot program be initiated in which engineering-geologic map folios would be prepared for parts or all of three major cities in the United States. The three cities should represent: (a) widely divergent environmental conditions, (b) varying quantities of existing and available environmental data, and (c) divergent conditions in regard to the character and number of shelter spaces currently available. Cities which might meet such criteria include San Francisco, Seattle, Phoenix, Denver, Kansas City, St. Louis, Minneapolis, Detroit, Atlanta, Philadelphia, and Boston. Various types of cooperative financing should be sought for this pilot program.

73. The OCD Staff Coordinator for Environmental Data should serve in an advisory capacity in the implementation of this program. A research design and a cost estimate for the program are included in Appendix E.

**APPENDIX A: ENVIRONMENTAL DATA CATEGORIES**

## APPENDIX A: ENVIRONMENTAL DATA CATEGORIES

General Statement

1. The following list of environmental data categories was prepared by personnel of the WES, working in cooperation with OCD personnel and research project contractors of the OCD. It serves as a basis for an appraisal of the current national status of environmental information pertinent to the needs of the OCD.

2. Underscored subcategories are those which appear to be derivatives or functions of other, more fundamental subcategories.

3. Probable OCD applications of the various data categories listed below are represented by a series of numbers in parentheses following the headings to which they apply. The specific applications which these numbers represent are as follows:

1. General shelter design problems
2. Shelter site selection
3. Shelter construction
4. Shelter ventilation and cooling
5. Shelter water supply
6. Post-attack emergency water supply
7. Fire potential
8. Fallout pattern
9. Decontamination problems
10. Emergency communications
11. Thermal countermeasures
12. Evacuation
13. Public relations

Data Categories

## I. TERRAIN CONFIGURATION

- A. Megageometry (1, 2, 7, 8, 9, 10, 12)
- B. Microgeometry (9)

II. SOILS

- A. Soil type (engineering and pedologic classification)  
(1, 2, 3)
- B. Chemical and mineralogical composition (2, 3, 9)
- C. Physical properties (1, 2, 3, 4)
- D. Distributional data (thickness, areal extent) (1, 2, 3)
- E. Construction characteristics (1, 2, 3)
- F. Trafficability characteristics (2, 12)

III. BEDROCK

- A. Rock type (engineering and geologic classification)  
(1, 2, 3)
- B. Chemical and mineral composition (2, 3)
- C. Weathering characteristics (2, 3)
- D. Physical properties (1, 2, 3, 4)
- E. Distributional data (thickness, areal extent)
- F. Construction characteristics (1, 2, 3)

IV. GEOLOGIC PHENOMENA

- A. Structural relations (1, 2, 3)
- B. Mass-wasting potential (2, 3)
- C. Seismic potential (1, 2, 3)

V. VEGETATION

- A. Major vegetative types (7, 9)
- B. Physiognomy (1, 2, 3, 8)
- C. Fire propagation characteristics (1, 2, 3, 7, 12)

VI. GROUNDWATER

- A. Type of groundwater body (4, 5, 6)
- B. Distributional data (depth, extent) (1, 2, 4, 5, 6)
- C. Geologic relation of groundwater body (5, 6)
- D. Permeability and transmissibility of aquifer and vadose zone (5, 6)
- E. Physical properties of water (4, 5, 6)
- F. Chemical properties (1, 5, 6)
- G. Feasibility of well installation (4, 5, 6)
- H. Hardware data on existing wells (5, 6)

VII. SURFACE WATER

- A. Runoff velocity and discharge (1, 2, 3, 6)

- B. Inflow-outflow relations for standing water bodies (6, 9) 9)
- C. Distribution data (drainage basin limits, etc.) (6, 7)
- D. Physical and chemical characteristics (4, 12)
- E. Storm and tidal effects (1, 2, 3)
- F. Utilization (6, 9)

#### VIII. TEMPERATURES

- A. Air temperature; standard observational data and micro-climatic data (4, 8, 11) o-
- B. Earth temperature (1, 4, 6)

#### IX. RADIATION

- A. Type
- B. Dimensional data (intensity, duration) (4)
- C. Modifying effects (cloud cover, etc.) (4)

#### X. PRECIPITATION AND OTHER ATMOSPHERIC MOISTURE

- A. Type
- B. Dimensional data (volume, intensity, frequency, direction) (1, 6, 7, 8, 9)
- C. Cloud cover and fog (8, 11)

#### XI. WINDS

- A. Near surface (4, 7, 9)
- B. Winds aloft (8)

#### XII. BACKGROUND RADIATION COUNT

- A. Cosmic (13)
- B. Soils and bedrock (1, 13)
- C. Water
- D. Food products

#### XIII. RADIO PROPAGATION AND ELECTROMAGNETIC PHENOMENA

- A. Ground conductivity (10)
- B. Spectrum characteristics (10)
- C. Climatological and auroral effects (10)
- D. Secular effects
- E. Level of ambient industrial noise
- F. Terrain and architectural obstructional effects (2, 10) 0)

APPENDIX B: APPRAISAL OF STATUS OF ENVIRONMENTAL DATA,  
TABULAR SUMMARIES BY CATEGORY

Table B1  
Appraisal of Status of Terrain Configuration Data

Source	Type of Information	Subject and Area of Coverage	Degree of Detail	Published vs Unpublished	Format of Unpublished	Availability of Unpublished	Comments
U. S. ARMY ENGINEER WATERWORKS EXPEDITION STATION	Reports and maps	Development of techniques and methodology for quantitative description of terrain configuration; application of these techniques to selected areas in U. S. and overseas	Highly detailed for some studies; generalized for others	Published data in technical reports; limited to descriptions of terrain and its configuration; techniques and methodology available in manuscript form	Terrain analysis data of somewhat limited value	Direct contact required	Emphasis is on development of technique and its application to selected areas, rather than on extensive data collection and mapping programs
QUARTERMASTER RESEARCH AND ENGINEERING COMMAND	Reports and Journal Articles	Development of techniques for selected aspects of quantitative terrain analysis problems	Generally highly detailed for selected problems	Precisely significant unpublished material	No information	Direct contact required	Emphasis is on development of technique and its application to selected areas, rather than on extensive data collection and mapping programs
U. S. GEOLOGICAL SURVEY	Geologic Division	Military Geology Branches	Qualitative or semiquantitative description of terrain units related principally to military ground movement (men and vehicles) almost exclusively foreign areas	Relatively generalized	Not applicable because of foreign subject matter	Not applicable	
UNIVERSITIES	e.g. Vanderbilt University, University of Southern California	Reports and Journal Articles	Research on development of basic principles and techniques for quantitative analysis of terrain; applied research on selected problems	Generally highly detailed for selected problems	Most research work data published upon completion of project	Direct contact required	Emphasis is on development of technique and its application to selected areas, rather than on extensive data collection and mapping programs

Table No.  
Availability of Various Soil Data

Source	Type of Information	Subject Soil	Area of Coverage	Degree of Detail	Published vs Unpublished	Format of Unpublished	Availability of	Comments
U. S. ARMY ENGINEER WATERWAYS EXPERIMENT STATION	Site maps, reports, samples, borings, logs, cores	Engineering soil quadrangle maps, numerous soil profiles, soil logs, cores available, see U. S. Investigations data for Boulder and Colorado River Basins	Varied, but typically relatively detailed	Unpublished bulk material, but bulk samples highly detailed	Manuscripts, maps, borings reports, file data	Direct contact required	Some work on soils done in cooperation with Department of Agriculture	
U. S. ARMY CORPS OF ENGINEERS	Division and District Offices	Naps., reports, etc.	Nightly similar to above	Varied, but typically moderately to highly detailed	Bulk material unpublished	Manuscripts, maps, borings reports, file data	Direct contact required	Emphasis on engineering sites
U. S. GEOLOGICAL SURVEY	Geologic Division	Quadrangle and site maps, boring logs, samples, cores	Engineering geological maps, depth to bedrock, soil, urban ecology, porosity, site investigation generally for other government agencies; engineering soils data and engineering boring and water-well logs	Often engineering maps, generally 1:15,000, but 1:10,000 to 1:20,000 in basin site maps; very large soils; engineering soils; very detailed water-well logs	Bulls. of the original unpublished	Manuscripts, maps, first reports, file data	Direct contact required	Emphasizes variety between soils and bedrock depending on which causes engineering problems
Engineering Geology Branch								
Ground Water Branches	Naps., reports, well logs, pumping test data	Extensive area or county map and report program; probable best source of well log information, but probably little or no engineering soils information	Maps typically 1:13,000 or larger, emphasis on aquifers	Considerable published material, but bulk unpublishable	Manuscripts, maps, borings reports, file data	Direct contact required	Little data on soils except where they contain water sources	
Military Geology Branches	Engineering soil maps	Data on foreign areas compiled from published sources; little or none on U. S.	Moderately detailed to very generalized	Information of little interest to the CSD because foreign in character				
U. S. BUREAU OF RECLAMATION	Engineering soil maps, boring logs, physical tests data on soils at engineering project sites; majority of data pertinent to soil mechanics	Activities limited to arid west and western portions of U. S.	Moderately detailed	Considerable data published in technical records, engineering reports, geological reports, and others; however, probably bulk of data unpublished	Maps, manuscripts, reports, file data	Direct contact required	Most published and unpublished data held in Denver office; Agency also maintains field offices	
	soil mechanics			(Continued)				
				(Continued)				

Table K (Continued)

Source	Type of Information	Subject and area of coverage	Degree of detail	Estimated cost per unit	Format & availability	Availability of analytical facilities	Comments
BUREAU OF PUBLIC ROADS	Site and strip maps, reports	Engineering soil inventories; coverage of public roads only, most data held in regional or divisional offices; some few special maps and reports, i.e., Yellowstone Park	Moderately detailed to very generalized	About all strip-lined	Map, manuscript, report, title data	Direct contact required	Cost of project is comparative with states; there are many strip lines taken from state geological surveys; analysis date recorded at only 6 of 11 regional offices
SOIL CONSERVATION SERVICE	Soil maps and profile data, and chemical and mineralogical analyses	Soil classification and mapping data, generally for shallow depths (about 6 ft), stress relatively and agriculturally important mechanical analysis data for each unit surveyed generally by counties	Maps made from 1:3,000 to 1:20,000 scale field mapping data; very large scale	Handbook published	Map, manuscript, report, title data	Direct contact required	Limited distribution of data; information available, but no analytical facilities data in Bettendorf, Iowa, therefore, limited
STATE HIGHWAY DEPARTMENTS	Route (strip) and site maps, and investigation records	Extensive program for ecological strip maps in many states; maps areas highway routes, not quadrangles; 10 or 15 states have extensive soil and material surveys underway; 6 states have statewide engineering-soil surveys	Moderately to highly detailed; low of both soil and mineral holes across entire horizon properties rather than clayey	Book of material published	Map, manuscript, report, title data	Direct contact required	
SPACE GEOLOGICAL SURVEYS	Engineering soil maps, etc., maps, boring logs	Relatively few state surveys have publications with such programs, and those with such programs generally have extensive files for state surveys commonly cooperative with state highway department	Moderately to highly detailed	Large volume of unpublished data	Map, manuscript, report, title data	Direct contact required	
POLARIZATION INCIDENCE- IN FIRS	Boring logs	Voluminous files for areas of interest	Logs and soil test data very detailed, but generally stress engineering properties rather than geology	Data sheet, map, Neph. manuscript, report, title data	Direct contact required	Because of somewhat nature, such data may be difficult to obtain	

Table B3  
Appraisal of Status of Bedrock Data

Source	Type of Information	Subject and Area of Coverage	Degree of Detail	Published vs Unpublished	Format of Unpublished	Availability of Unpublished	Comments
<b>U. S. GEOLOGICAL SURVEY</b>							
Geologic Division							
National Geologic Branches	Descriptive reports and maps for quadrangles and other selected areas; well logs, cuttings, and cores; measured sections; some information on geological processes; stratigraphic, structural, and compositional information; U. S. and territorial areas covered, with emphasis on areas of geologic interest.	Map scales vary from 1:25,000 to 1:50,000; 1:63,000 probably most typical.	Large volume of published material, but even more unpublished.	Manuscripts, well logs, file data or a variety of types	Direct contact required	Agency has national archival responsibility for reduced information; size of agency precludes comprehensive appraisal of all branches	
Economic Geology Branches	Area distribution, geological occurrence, and compositional information on (1) base and ferrous metals, (2) light metals and non-metals, (3) organic fuels, (4) radioactive materials, and (5) minor elements (in tables, maps, sections, and reports). Plus technical exploration information, engineering geological data in the form of quadrangle maps, engineering data on bedrock, engineering borings, and various well log site maps. U. S. and territories; but emphasis is definitely on areas of potential or actual mineral resources; engineering studies program emphasis on urban areas (20 or so) and other selected areas	Varies widely (highly detailed for several areas), but occurrences typically summarized at small scale; engineering geological maps and typical cross-sections maps on 1:25,000 scale	Large volume of published material, but even more unpublished	Manuscripts, maps, statistical data, well logs, sample test data	Direct contact required		
Experimental Geology Branches	Data include bulletins and reports and voluminous unpublished data on several aspects of geochemistry, on theoretical geophysics, mineralogy, composition of rock materials, and isotopic geology; U. S. and territories covered by topics as outlined above	Varies greatly with area and topic	Large volume of published material, but even more unpublished	Manuscripts, statistical data, sample analyses, file data	Direct contact required	Chemical analysis of rock composition recorded on punch cards, and retrieved by machine	
Other Branches, including Military Geology, Special Projects, and Astronautics Branches	Selected aspects of geological data which apply to military problems; problems of nuclear testing, composition of rock materials, and isotopic properties; some U. S. military reservations	Varies widely	Large volume of published material, but even more unpublished	No information	Direct contact required		
U. S. ARMY CORPS OF ENGINEERS	Engineering reports and maps; boring records, samples, cores, sections	Site investigations, detailed depth to bedrock, structure and composition of bedrock, engineering properties; general geologic data	Generally limited to West site investigations; and highly detailed for construction sites; some regional maps	Manuscripts, boring logs, sample analyses, maps	Direct contact required	File data held at district and local office level	

(Continued)

unpublished

(Continued).

Table B3 (Concluded)

Source	Type of Information	Subject and Area of Coverage	Degree of Detail	Published vs Unpublished	Format of Unpublished	Reliability of Unpublished	Comments
STATE GEOLOGICAL SURVEYS	Statewide to U. S. Geological Survey; but much less comprehensive; areas of coverage restricted to given state	Varies widely from state to state; county report and map series relatively common	Varies, but large volume of work unpublished	Manuscripts, birling load, sample analysis, maps	Direct contact required	Unpublished	
UNIVERSITIES	Theses and dissertations	Selected geological problems are subject of intensive research	Highly detailed for subjects covered	Many theses and dissertations published	Reports, maps, file data	Direct contact required; completed but unpublished theses and dissertations available from university libraries.	Character of subject matter for research varies widely from university to university.

Table 5a  
International Status of Seismic Phenomena

Source	Type of Information	Subject and Area of coverage	Source of detail	Published or Unpublished	Availability of unpublished
<b>U. S. GEOLOGICAL SURVEY</b>					
Geologic Division					
Engineering Geology Branches	Reports, maps, bore hole records, samples, cores	Selected areas of U. S. and territories; (a) selected areas; (b).	Varied, but typically detailed.	Published or unpublished	Direct contact required.
Regional Geology Branches	Reports, maps, bore hole records, samples, cores	Selected areas of U. S. and territories; (a).	Varied.	Unpublished data	Direct contact required.
Geophysical Branches	Reports, maps	Selected areas of U. S. and territories; (a)	Varied.	Published or unpublished	Direct contact generally required.
<b>U. S. ARMY CORPS OF ENGINEERS</b>					
District and local offices and Water Experiment Station	Reports, maps, bore hole records, sample plots, cores	Most of U. S.; (a) and (b).	Varied with some highly detailed for major metropolitan areas.	Published or unpublished	Direct contact required.
NATIONAL RESEARCH AND STUDIES	Reports, special studies	Item (b), with particular emphasis on land slides and frost effects; no coverage.	Item (b), precise and multiaxial detail.	Not yet published or information	No information
<b>SEISMOLOGICAL DIVISIONS (university connected) and DATA CENTER (VSILAC)</b>					
	Reports, maps, seismic records	Seismological activity of appropriate areas; more emphasis on nature of specific quakes than on general seismometry; (c).	Generally very detailed; length and quality of seismic records vary.	Probably unpublished.	Information and analysis.
<b>PROFESSIONAL SOCIETIES</b>					
American Society of Civil Engineers, Soil Mechanics and Foundation Division, American Geological Society	List of specialists	(a), (b), and (c)	Not applicable	Not applicable	Not applicable
FOUNDATION ENGINEERING FIRMS	Gage histories, boring records	(a) and principally (b) for engineering sites.	Very detailed	Unpublished data	Direct contact required.

\* Symbols indicate which of the following phenomena are involved: (a) structural relations; (b) mass-wasting potential; (c) seismic potential

\* Symbols indicate which of the following phenomena are involved: (a) structural relations; (b) mass-wasting potential; (c) seismic potential

Table II illustrates the results of the experiments.

AFFIRMATION OF JEWISHNESS IN THE BIBLE

Source	Type of Information	Subject and Area of Coverage	Direct or General	Published vs Unpublished	E-mail or Telephone	Availability
U. S. Forest Service AGRICULTURE	Reports, maps, statistical data; extensive programs under way for mapping aerial surveys, of major forest types (in Forest Service "interim reports") are available for all states except Alaska, Arizona, Colorado, Hawaii, Kansas, Nevada, New Mexico, Utah, West Virginia, present. Woodsat reports with maps should be available within 2 years; reports on counties or forest areas and contain maps of major forest types. Branches most basic information such as forest resources with information station, etc., is held in files of Regional Forest Experiment Stations.	Various widely from county to county and state to state. New pending on extent of forest resources present.	Published material	Varies	Direct contact via telephone, fax, e-mail, or mail.	Information to be made available through the Forest Service's various branches.
U. S. Forest Service AGRICULTURE	There are more than 6 branches of Forest Service, Alaska, Arizona, Colorado, Hawaii, Kansas, Nevada, New Mexico, Utah, West Virginia, present	Woodsat reports with maps should be available within 2 years; reports on counties or forest areas and contain maps of major forest types. Branches most basic information such as forest resources with information station, etc., is held in files of Regional Forest Experiment Stations.	Published material	Varies	Direct contact via telephone, fax, e-mail, or mail.	Information to be made available through the Forest Service's various branches.
U. S. Forest Service AGRICULTURE	Reported, maps, statistical data; extensive programs under way for mapping aerial surveys, of major forest types (in Forest Service "interim reports") are available for all states except Alaska, Arizona, Colorado, Hawaii, Kansas, Nevada, New Mexico, Utah, West Virginia, present. Woodsat reports with maps should be available within 2 years; reports on counties or forest areas and contain maps of major forest types. Branches most basic information such as forest resources with information station, etc., is held in files of Regional Forest Experiment Stations.	Various widely from county to county and state to state. New pending on extent of forest resources present.	Published material	Varies	Direct contact via telephone, fax, e-mail, or mail.	Information to be made available through the Forest Service's various branches.
UNIVERSITIES	Technical Analysis Branch	Wide variety of information on vegetation	Varies	Highly detailed	AS Technical Information Service, then to AS, over Internet, or via mail. This is the only anticipated course since there are thousands of publications available.	Volume of work and literature is enormous; that person seeking information other than directly to AS Technical Information Service, then to AS, over Internet, or via mail. This is the only anticipated course since there are thousands of publications available.
UNIVERSITIES	UNIVERSITY FOREST AGENCIES	Maps, reports, statistical data	Varies from highly generalized reports to generalizations	Varies from highly detailed reports to generalizations	Largely maps and statistical data	Such "live" material is probably as highly technical in nature as the relatively little application to the work of the CFS
UNIVERSITIES	UNIVERSITY FOREST AGENCIES	Theses, dissertations, reports	Selected problems are subject of intensive research	Highly detailed for jubilea covered	Voluminous unpublished material	Considerable unpublished material covered
UNIVERSITIES	UNIVERSITY FOREST AGENCIES				Reports, file data	Completed but unpublished theses and dissertations available from universities libraries

Table 16  
Appraisal of Status of Groundwater Data

Source	Date of Information	Subject and Area of Coverage	Degree of Detail	Published vs Unpublished	Format of Unpublished	Availability of Unpublished	Comments
<b>U. S. GEOLOGICAL SURVEY</b>							
Water Resources Division							
Ground Water Branches		Water-table configuration, including variation in groundwater levels and water tables; maps, charts, tables, cross sections, and extensive file data	Reports and maps	Voluminous publications, but still more voluminous in-house data files	Varies widely, perhaps, maps, numerical tabulations, and artesian pressures, probably considerable unprocessed data as well	Data concerning groundwater levels, artesian pressures, and water quality may be obtained in advance of publication on request to the Director, U. S. Geological Survey, Washington, D. C.; other data may be obtained by direct contact with local offices	
Quality of Water Branches		Water-table configuration, i.e., chemical characteristics; U. S. and territories	Data moderately detailed, but number of maps, etc., varies with area	Incidental summary publications annually; complete data in files	Numerical tabulations, and basic chemical analyses	Direct contact with local offices required	
U. S. ARMY CORPS OF ENGINEERS		Engineering reports and maps, plus voluminous file data	Water-table configuration, chemical quality, ground-water movement, pressures, and recharge	Generally limited to construction sites; some regional mapping	Boring and excavation records	File data held in district and local offices	
<b>STATE ORGANIZATIONS</b>							
Surveys, Boards, and Authorities		Subject matter similar to U. S. Geological Survey; areas of coverage restricted to given state; degree of coverage for given state varies widely	Varies widely from state to state and within state; reports and maps for counties and parts of state common	Varies, but large volume of data unpublished	Varies widely; probably similar to U. S. Geological Survey above	Direct contact required; file data held in state and local offices	
MUNICIPAL ORGANIZATIONS		Limited reports, principally unpublished file data	Subject matter varies widely; areas restricted to given city and related water source area	Varies, quite detailed for critical problems areas	Varies; maps, well published records	Direct contact required	(Continued)

(Continued)

(Continued)

Table B6 (Concluded)

Source	Type of Information	Subject area	Area of Coverage	Degree of Detail	Published vs unpublished	Format of Information	Availability of unpublished	Comments
<b>COMMERCIAL ORGANIZATIONS</b>								
Well Advisers	Normally; only back-ground experience; little or no written or published data available	Depth to water table		Commonly very detailed, but reliability sometimes questionable	Not applicable	Not applicable	Direct contact required	
FOUNDATION ENGINEERING FIRMS	File data	Depth to water table		Varies with quality of records and significance of problem	Data unqualified	Boring results	Direct contact required. (Commercial interest may restrict availability of data)	

Table 57  
Availability of statistical hydrogeologic data

Source	Type of Information	Subject and Area of Coverage	Period of Record	Period of Availability	Method of Availability	Comments
<b>U. S. GEOLOGICAL SURVEY</b>						
Water Resources Division	Descriptive reports, statistical summaries, and hydrologic investigation atlases	Surface-water runoff (streamflow, i.e. data from 700 control points collected daily); discharge, travel time (inlet to point) for water in rivers; floods (amplitude and frequency); drought information on water availability; supply capacities; hydrologic literature; and hydrologic theoretical and experimental work	Variable period; generally monthly (1 month to 1 year); with some points to 100 meters to mill.) for metric units.	Most data probably in files of individual investigators, and in periodic lists filed in annual reports to Director, U. S. Geological Survey, and Director, U. S. Bureau of Reclamation, and Director, U. S. Army Corps of Engineers, and Director, U. S. Fish and Wildlife Service.	Descriptive data may be obtained in advance of publication in request to the Director, U. S. Geological Survey, and Director, U. S. Bureau of Reclamation, and Director, U. S. Army Corps of Engineers, and Director, U. S. Fish and Wildlife Service.	
Quality of Water Branches	Reports and numerical summaries	Water chemistry (influence, occurrence, and disappearance of pollutants); rainfall-runoff relations; river discharge; soil-surface characteristics; and chemical analyses; selected chemical analyses sampled at 750 points	Data monthly; basically in form of tables, graphs, and maps. Data available generally, but direct access probably required.	Most data probably in form of numerical tables.	Most data probably in quality-control form of numerical tables.	
U. S. ARMY CORPS OF ENGINEERS	District offices	Yearly publication (since 1932) of stage and discharge records for all major streams	Varied from year to year.	All records published yearly.	Not applicable.	All data copyrighted, although public records in the United States are kept in public domain. Data can be obtained by application to the Director, U. S. Army Corps of Engineers, Washington, D. C.
U. S. WEATHER BUREAU	Hydrologic Service Section	Forecasts via mass media; various reports	Detailed 1 - week areas	Statistical summaries, press releases, forecast files, and detailed file data.	Generally readily available	The more specific the requests, the more easily is the data retrieved.

(Continued)

analysis, or as bulk territories

(Continued)

Table B7 (See Table 4)

Source	Type of Information	Subject and Area of Interest	Particulars of Source	Source of Detail	Particulars of Source	Source of Detail	Particulars of Source	Source of Detail
<b>STATE ORGANIZATIONS (Boards and Authorities)</b>								
	Special reports	Studies on selected hydrologic problems generally held by the U.S. Army Corps of Engineers.	Potentially useful, particularly relevant to localities where hydroelectric potential is little, but same state has no programs	Particulars of Source				
<b>MUNICIPAL ORGANIZATIONS</b>								
	Mostly special reports	Debtors' records, availability of loans, implementation and financing plans and programs, rely heavily on state and unit activities of federal and state organizations within a given city and environs	Potentially useful, mostly relevant to water, power, and electric power	Potentially useful, mostly relevant to water, power, and electric power	Potentially useful, mostly relevant to water, power, and electric power	Potentially useful, mostly relevant to water, power, and electric power	Potentially useful, mostly relevant to water, power, and electric power	Potentially useful, mostly relevant to water, power, and electric power
<b>UNIVERSITIES AND INSTITUTES</b>								
	Reports	Selected analyses of surface-water and water-resource problems	Generally timely, detailed	Particulars of Source				

Table B8  
Appraisal of Status of Climatic Data

Source	Type of Information	Subject and Area of Coverage	Degree of Detail	Published vs Unpublished	Format of Unpublished	Availability of Unpublished	Comments
U. S. WEATHER BUREAU National Weather Records Center	(a), (b), (c), (d)* considered from such aspects as: weather forecasting, meteorology, climatology, and atmospheric physics	12,000 local observations; length of record and spacing of observing points varies	Voluminous published summaries, but unpublished material is much more voluminous	Primarily punch and data tape and printed library	Readily available through machine readout	Information desired should be listed as specifically as possible; Navy and Air Force weather services are linked with National Weather Records Center	
Office of Meteorological Research	(a), (b), (c), (d)	Not applicable	Probably considerable unpublished material	Manuscript, file data	Probably direct contact required	Information desired should be stated as specifically as possible	
National Meteorological Center	Forecasts	Area as large as Northern Hemisphere for weather forecasts of (a) through (d) (daily and 5-day forecasts); 30-day outlooks	Records from sea level to 60,000 ft; taken as often as 8 times daily	Most data published	Not applicable	Not applicable	
METEOROLOGY DIVISION NATIONAL BUREAU OF STANDARDS	Reports	Following selected aspects of items (a) through (d): photometry and colorimetry, refractometry, meteorology, meteorology, volumetry, densimetry	Very detailed on pertinent topics	Probably voluminous unpublished data	No information	Probably direct contact required	
UNIVERSITIES - including National Center for Atmospheric Research	Reports and studies	Research on selected aspects of (a) through (d) for moving meteorological and climatological problems	Generally highly detailed for specific topics	Varies, but probably significant amount unpublished	No information	Direct contact required	
PROFESSIONAL SOCIETIES	American Meteorological Society	Technical and popular articles in journals and bulletins; periodic publication of abstracts and bibliographies	International in scope; covers all aspects of atmospheric sciences	Varies from general to highly detailed	Not applicable	Activities include: abstracting service, translation service, scientific committee, professional directory, national register	

\* Symbols indicate which of following phenomena are involved: (a) temperature, (b) radiation, (c) precipitation and other atmospheric moisture, (d) wind

Table 39  
Appraisal of Status of Background Radiation "Non-Data"

Source	Type of Information	Subject and Area of Coverage	Degree of Detail	Published vs Unpublished	Format of Published	Availability of Published
ATOMIC ENERGY COMMISSION	Literature summaries, reports of investigations	Summaries and investigations cover many aspects of (a) through (d)*	Detailed	Volumeous publications by listed products, frequently still larger volumes of unpublished data	No data	Direct through TIS of AEC, security classified which may restrict availability of much data
NATIONAL BUREAU OF STANDARDS	Reports	(a) presumably one of the subjects studied by Los Alamos Research and Upper Atmosphere and Space Physics Division of the National Bureau of Standards	No data	No data	No data	Prominently research oriented, Information Office of National Bureau of Standards
U. S. GEODRICAL SURVEY	Various branches	Reports	Primarily (b) and (c); derived data incident to major projects of the U.S.G.S.	Probably bulk is unpublished	No data	Prominently direct contact required
U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE	Division of Radiologic Health	Monthly summary	(c) and (d); wide sampling	Varies	No data	Direct contact required
U. S. DEPARTMENT OF AGRICULTURE	No information	No information	Various aspects of (a)	No information	No information	Prominently direct contact required

\* Symbols indicate which of following phenomena are involved: (a) cosmic, (b) soils-bedrock, (c) water, (d) food products

\* Symbols indicate which of following phenomena are involved: (a) cosmic, (b) soils-bedrock, (c) water, (d) food products

Table H1  
Availability of Types of Radio Propagation and Related Scientific Papers

Source	Type of Information	Subject and Area of Interest	Degree of Detail	Probability of Finding	Probability of Finding	Probability of Finding
<b>NATIONAL BUREAU OF STANDARDS</b>						
Central Radio Propagation Laboratory	The laboratory consists of the following divisions: (1) Ionosphere Research and Prediction; (2) Radio Reception and Emission; (3) Radio Communication and Systems; (4) Upper Atmosphere and Space Physics.	Precisely identifying particular subjects. Detailed information.	Precisely identifying particular subjects. Detailed information.	Precisely identifying particular subjects. Detailed information.	Precisely identifying particular subjects. Detailed information.	Precisely identifying particular subjects. Detailed information.
Extremely wide variety of subject matter appropriate to division or each division; National Bureau of Standards is affiliated U. S. repository for this type of data, reports and journal articles						
FEDERAL COMMISSIONS	Various types of technical reports and publications	Selected aspects of radio propagation and interference problems.	Written	Precisely identifying particular subjects.	Precisely identifying particular subjects.	Precisely identifying particular subjects.
UNIVERSITIES	Journal papers	Precisely identifiable research work on selected aspects of radio propagation and electron emission and electron multi-problem.	Identifiable by particular topics.	Precisely identifying particular topics.	Precisely identifying particular topics.	Precisely identifying particular topics.
COMMERCIAL AND PRIVATE RESEARCH ORGANIZATIONS						
e.g. Electro-Magnetic Compatibility Analysis Center of Army Research Foundation	Research on extremes within range of radio propagation and electromagnetic problems; emphasis generally on applied research; generally no major effort on compilation of basic data	Extremely detailed on particular topics.	Precisely identifying particular topics.	Precisely identifying particular topics.	Precisely identifying particular topics.	Precisely identifying particular topics.

APPENDIX C: EXAMPLE OF DIRECTORY OF ENVIRONMENTAL DATA SOURCES 33

**A DIRECTORY OF ENVIRONMENTAL DATA SOURCES**

Prepared for the  
**OFFICE OF CIVIL DEFENSE**

By  
**U. S. Army Engineer Waterways Experiment Station**  
**CORPS OF ENGINEERS**  
**Vicksburg, Mississippi**

**Prefatory Note**

The following pages are an example of a highly detailed or first, second, and third order directory of environmental data sources (see Appendix E, paragraph 6). This example includes only representative pages selected from the Bedrock and Climate categories. These illustrate the type of subject matter, coverage, degree of detail, and format of the proposed directory. Examples of index pages are also included.

It is emphasized that the data contained in this example have not been checked with the source agencies, and must therefore be considered illustrative only.

## DIRECTORY OF ENVIRONMENTAL DATA SOURCES

CONTENTSTERRAIN CONFIGURATION**NATIONAL**

General  
Megageometry  
Microgeometry

**BY STATES**

Same topics as applicable

SOILS**NATIONAL**

General  
Engineering soil type  
Chemical and mineralogical properties  
Physical properties  
Thermal properties  
Construction characteristics  
Trafficability characteristics

**BY STATES**

Same topics as applicable

EXAMPLE PLE

BEDROCK**NATIONAL**

General  
Rock type (geological classification)  
Rock type (engineering-geologic classification)  
Chemical and mineralogic composition  
Weathering characteristics  
Physical properties  
Thermal properties  
Construction characteristics

**BY STATES**

Same topics as applicable

EXAMPLE INCLUDES  
ALABAMA ONLYGEOLOGIC PHENOMENA**NATIONAL**

General  
Structural relations  
Mass wasting potential  
Seismic shock

**BY STATES**

Same topics as applicable

VEGETATION**NATIONAL**

General  
 Physiognomy  
 Fire propagation characteristics

**BY STATES**

Same topics as applicable

GROUNDWATER**NATIONAL**

General  
 Type and dimensions of water body  
 Geological relationship of water body  
 Physical properties of aquifer  
 Physical and chemical properties of water  
 Feasibility of well installation  
 Hardware information

**BY STATES**

Same topics as applicable

SURFACE WATER**NATIONAL**

General  
 Physical and chemical characteristics  
 Dimensional information (size of drainage basin, etc.)  
 Volume and discharge information  
 Utilization

**BY STATES**

Same topics as applicable

EXAMPLE WPL

CLIMATE**NATIONAL**

General  
 Temperature  
 Precipitation  
 Other atmospheric moisture  
 Radiation  
 Winds  
 Special climatic effects

**BY STATES**

Same topics as applicable

BACKGROUND RADIATION**NATIONAL**

General  
 Cosmic  
 Soils and bedrock  
 Other materials

BY STATES  
Same topics as applicable

c6 c6

RADIO PROPAGATION AND ELECTROMAGNETIC PHENOMENA

**NATIONAL**

- General
- Ground conductivity
- Spectrum characteristics
- Climatological and auroral effects
- Secular effects
- Man-made noises
- Others

**BY STATES**

- Same topics as applicable

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B E D R O C K

## BEDROCK - NATIONAL

### GENERAL

#### AGENCIES:

Geologic Division, U. S. Geological Survey,  
General Services Administration Building  
F Street between 18th and 19th Sts., N.W.  
Washington 25, D. C.  
Area Code: 202, REpublic 7-1820 (Fed. Code 183)  
*T. B. Nolan, Director; Charles E. Anderson, Chief Geologist*

Geologic Division activities include geologic, geochemical, and geophysical investigations in following branches:

1. Economic Geology Branches:  
Base and Ferrous Metals  
Engineering Geology  
Geochemical Exploration and Minor Elements  
Light Metals and Industrial Minerals  
Organic Fuels  
Radioactive Materials
2. Regional Geology Branches:  
New England  
Eastern States  
Kentucky  
Southern Rocky Mountains  
Northern Rocky Mountains  
Southwestern States  
Pacific Coast States  
Alaska  
Paleontology and Stratigraphy  
Paleotectonic Maps  
Regional Geophysics
3. Experimental Geology Branches:  
Crustal Studies  
Experimental Geochemistry and Mineralogy  
Field Geochemistry and Petrology  
Isotope Geology  
Theoretical Geophysics  
Geochemical Census
4. Other Branches:  
Analytical Laboratories  
Astrogeology  
Foreign Geology  
Library  
Military Geology  
Special Projects

Principal Offices at Federal Center, Denver 25, Colorado, and at 345 Middlefield Road, Menlo Park, California.

## BEDROCK - NATIONAL

### GENERAL

#### MAPS:

1. "Geologic map of the United States," U. S. Geological Survey, 1932. Scale - 1:2,500,000.
2. "Tectonic map of the United States," American Association of Petroleum Geologists, 1944. Scale - 1:2,500,000. Out of print, being revised.
3. "Basement rock map of North America from 20° to 60° N. latitude," U. S. Geological Survey. Scale - 1:5,000,000. Compiled by a committee of the American Association of Petroleum Geologists, P. T. Fawcett, chairman.
4. "Rock types map of Alaska," by L. A. Yehle. U. S. Geological Survey, research in progress, 1961.
5. "Map of the landforms of the United States," by E. Raisz. Institute of Geographical Exploration, Cambridge, 1943. 3d rev. ed. Copies may be obtained from the author (Harvard University) at \$0.50 each.

#### BIBLIOGRAPHIES:

1. "Bibliography of North American geology," U. S. Geological Survey. Published in the Bulletin series as follows: 746-747 (1785-1918), 823 (1919-28), 937 (1929-39), 938 (1940-41), 949 (1942-43), 952 (1944-45), 958 (1946-47), 968 (1948), 977 (1949), 985 (1950), 1025 (1951), 1035 (1952-53), 1049 (1940-49), 1054 (1954). Listed in Publications of the U. S. Geological Survey with prices of those in print.
2. "Geological abstracts," Geological Society of America. Published quarterly for the American Geological Institute. Contains authors' abstracts reproduced from most U. S. journals and publications of Government agencies. Limited foreign coverage. Order from the Geological Society of America.
3. "Bibliography of theses in geology," Petroleum Research Corporation, 1252 Arapahoe St., Denver, Colo. Lists name of author, title of thesis, degree, and data. Includes 84 colleges and universities.
4. "Directory of geological material in North America," by J. V. Howell and A. I. Levorsen. American Geological Institute, Washington, 1957. (NAS-NRC Publication No. 556).

#### LISTS OF PUBLICATIONS:

1. "Publications of the U. S. Geological Survey" (1880-1958). Revised and reprinted every 5 years (last issued in 1958); yearly supplement. Also issues monthly notices of new publications. Free on application to U. S. Geological Survey, Washington 25, D. C., Denver Federal Center, Denver, Colo., and Public Inquiries Offices at Denver, Salt Lake City, Utah, Los Angeles, Calif., and Anchorage, Alaska (see under states for local addresses).

## **BEDROCK - NATIONAL**

## **GENERAL**

**LISTS OF PUBLICATIONS (Con't):**

2. "Reports and maps of the Geological Survey released only in the open files, 1961," Betsy A. Weld, Erwin S. Asselstine, and Arthur Johnson, Geological Survey Circular 463, free on application to the U. S. Geological Survey, Washington 25, D. C.
3. "List of publications of the U. S. Bureau of Mines," order from U. S. Government Printing Office, Washington 25, D. C. Includes listings of bibliographies on various subjects. Cumulative list of publications issued by the Bureau of Mines from July 1, 1910, to Jan. 1, 1960.

List of Bureau of Mines publications and articles, Jan. 1 to Dec. 31, 1961, with subject and author index.

## **ROCK TYPE - GEOLOGICAL CLASSIFICATION**

## MAPS:

"Geologic map of the United States" (above). Shows areal distribution of rock systems with some subdivided into groups.

Larger scale geologic maps (of smaller areas of the United States) show areal distribution of groups and formations. Legend generally gives average rock types representative of the mapped stratigraphic units, i.e. Sundance sandstone or Morrison formation: shales, thin sandstones, etc. Larger scale maps give approximate thickness of unit, some information on lithologic variation vertically and laterally. See Index of Geologic Mapping (U. S. Geological Survey) for each state.

#### **HANDBOOKS AND OTHER REFERENCES:**

"Lexicon of geologic names of the United States," M. Grace Wilmarth, U. S. Geological Survey Bulletin 896, Part 1, A-L, Part 2, M-Z, 1938 (\$5.25 per set).

## **PHYSICAL PROPERTIES (Specific Gravity, Strength Properties, Deformation Characteristics)**

**AGENCIES:**

1. Theoretical Geophysics Branch, Geologic Division, U. S. Geological Survey,  
Washington 25, D. C.

## BEDROCK - NATIONAL

### PHYSICAL PROPERTIES (Specific Gravity, Strength Properties, Deformation Characteristics)

#### AGENCIES (Con't):

2. Geophysical Laboratory, Carnegie Institute of Washington

Washington 5, D. C.  
*Dr. Philip H. Abelson*, Director  
Area Code: 202, WOodley 6-0334

3. Applied Physics Research Laboratory

U. S. Bureau of Mines  
College Park, Maryland  
*Dr. Leonard Ober*, Chief  
Area Code: 202, UNiversity 4-3100

#### HANDBOOKS AND REFERENCES:

1. "Physics of the crust," by F. Birch. In: "Crust of the earth," Geological Society of America, Special Paper 62, 1955.
2. "Rock deformation," edited by D. Griggs and J. Handin. Geological Society of America, Memoir 79, 1960.
3. "Physical properties of evaporite minerals," by E. C. Robertson. U. S. Geological Survey, Open File Report No. TEI-821, 1962.
4. Papers published in: "Transactions of the Society of Rheology," E. H. Lee, Brown University, editor. New York: Interscience Publishers. Issued annually since vol. 1, 1957.
5. Papers published in: "Symposia on rock mechanics." The symposia are sponsored by the mining engineering departments of the University of Minnesota, Pennsylvania State University, and the Colorado School of Mines. First symposium 1956 through fifth symposium to be held April 1963 at the University of Minnesota.
6. Papers published in: "Journal of geophysical research." Issued monthly by the American Geophysical Union, 1515 Massachusetts Ave., N.W., Washington 5, D. C. Vol. 1 (1895) - present.

### PHYSICAL PROPERTIES (Freeze-Thaw Characteristics and Frozen-Ground Phenomena)

#### AGENCIES:

1. Cold Regions Research & Engineering Laboratory

U. S. Army Materiel Command  
P. O. Box 282  
Hanover, New Hampshire

2. Geophysics Branch, U. S. Geological Survey

Menlo Park, California  
*Dr. Arthur Lach*, Chief  
Area Code: 415, DAvenport 5-6761

## BEDROCK - NATIONAL

### PHYSICAL PROPERTIES (Freeze-Thaw Characteristics and Frozen-Ground Phenomena)

#### AGENCIES (Con't):

3. Division of Building Research  
National Research Council of Canada  
Ottawa, Canada

#### BASIC REFERENCES:

1. "Frost action in roads and airfields, a review of the literature 1765-1951,"  
Highway Research Board, Special Report No. 1, National  
Academy of Sciences - National Research Council Publication  
211, 2101 Constitution Ave., Washington 25, D. C. 1952.
2. "Frost action in soils" (a symposium), Highway Research Board,  
Special Report No. 2, National Academy of Sciences - National  
Research Council Publication 213, 2101 Constitution Ave.,  
Washington 25, D. C. 1952.
3. Publications of the Cold Regions Research & Engineering Laboratory (formerly SIPRE). Cover many aspects of frost action and frozen-ground phenomena. See particularly: "Review of properties of snow and ice," SIPRE Report 4, July 1961.

#### BIBLIOGRAPHIES:

1. "A bibliography on snow and ice," by D. C. Pearce, National Research Council of Canada, Publication No. 2534, October 1951.
2. "Bibliography on snow, ice, and permafrost with abstracts" (vols. 1 through 4 were titled "Annotated bibliography on snow, ice, and permafrost"), SIPRE. Vols. 1 (Sept. 1951) through 13 (Jan. 1959).

#### INDIVIDUAL AUTHORITIES:

1. *Prof. A. L. Washburn*  
Department of Geology  
Yale University  
New Haven, Connecticut  
(Frost action, mass wasting, solifluction, patterned ground)
2. *Prof. Troy L. Pearce*  
Department of Geology  
University of Alaska  
College, Alaska  
(Permafrost phenomena related to engineering problems)
3. *Mr. J. A. Philainen*  
Division of Building Research  
National Research Council of Canada  
Ottawa, Canada  
(Permafrost phenomena in relation to engineering problems)

## BEDROCK - NATIONAL

### PHYSICAL PROPERTIES (Freeze-Thaw Characteristics and Frozen-Ground Phenomena)

#### INDIVIDUAL AUTHORITIES (Con't):

4. Prof. K. B. Woods  
Joint Highway Research Project  
Purdue University  
Lafayette, Indiana  
(Frost action)
5. See also individuals cited in "Frost action in soils," Highway Research Board, Special Report No. 2, NAS-NRC Publication 213, 1952.

## CONSTRUCTION CHARACTERISTICS

Note: Little or no tabulated data are available for individual formations but considerable data are available in agency files concerning the properties of a given rock type. Some degree of prediction is possible with respect to specific characteristics. This is based on a detailed knowledge of the given rock type, its structural fabric, its past geologic history, and the historic record of its performance as an engineering material.

#### AGENCIES:

1. U. S. Army Corps of Engineers, Division and District Offices  
(See sections on various states for addresses)
2. Engineering Geology Branch, U. S. Geological Survey  
Branch and Local Offices  
(See sections on various states for addresses)  
  
Main Office:  
Federal Center  
Denver, Colorado  
Bldg. 25, Room 1830, Entrance G  
Mr. David J. Varnes, Chief  
Area Code: 303, BELmont 3-3611, Ext. 371
3. See also State Geological Surveys and State Highway Departments.

#### INDIVIDUAL AUTHORITIES:

1. Mr. Manuel G. Bonilla  
11 Rosalita Lane  
Millbrae, California
2. Mr. Edward B. Burwell, Jr.  
P. O. Box 116  
Upperville, Virginia
3. Mr. Edwin B. Eckel  
U. S. Geological Survey  
Federal Center  
Denver, Colorado

## BEDROCK - NATIONAL CONSTRUCTION CHARACTERISTICS

### INDIVIDUAL AUTHORITIES (Con't):

4. Mr. Clifford A. Kaye  
U. S. Geological Survey  
270 Dartmouth St.  
Boston 16, Massachusetts
5. Mr. George A. Kiersch  
Department of Geology  
Cornell University  
Ithaca, New York
6. Dr. Charles R. Kolb  
A.P.O. 731  
Seattle, Washington  
U. S. Army Research & Development Office, Alaska
7. Dr. John T. McGill  
Department of Geology  
University of California  
Los Angeles 24, California
8. Mr. Robert H. Nesbitt  
Office, Chief of Engineers  
Bldg. T-7  
Gravelly Point  
Washington, D. C.

### REFERENCES:

1. "Engineering properties of rocks," in: Principles of Engineering Geology and Geotechnics, by D. P. Krymire and W. R. Judd. New York: McGraw-Hill, 1957.
2. "Rock as a construction material," in: Principles of Engineering Geology and Geotechnics (see above).
3. "Symposium on surface and subsurface reconnaissance," American Society for Testing Materials, Special Technical Publication 122, Philadelphia, 1952.
4. "Geologic structure stability and deep protective construction," Air Force Special Weapons Center, Kirtland AF Base, New Mexico, Report No. TDR-61-93, November 1961.
5. "Engineering geology principles of subterranean installations," by G. A. Kiersch. Economic Geology, vol. 46, No. 2, pp. 208-222. Mar. 1951.
6. "Behavior of materials in the earth's crust," Quarterly of the Colorado School of Mines, vol. 52, No. 3, 1957. Includes papers on:  
(1) basic concepts of materials behavior, (2) deformation in geologic masses, (3) stress instrumentation and interpretation, and (4) support of underground openings.

## BEDROCK - NATIONAL CONSTRUCTION CHARACTERISTICS

### REFERENCES (Con't):

7. "Effects of elastic properties of rocks on civil-engineering structures," by W. R. Judd, (Abstract) Bulletin of the Geological Society of America, vol. 69, No. 12, Part 2, p. 1595, Dec. 1958.
8. "Graphical statistical analysis of fracture patterns in rock encountered in engineering projects," by A. E. Aho, Bulletin of the Geological Society of America, vol. 71, No. 11, pp. 1719-1720, Nov. 1960.

BEDROCK - BY STATES

C16

C16

ALA

ALABAMA

GENERAL

AGENCIES:

Geological Survey of Alabama

P. O. Drawer "O"  
University, Alabama  
Phone: 758-1604 Area Code: 205  
Philip E. LaMereaux, State Geologist  
Staff of five geologists

U. S. Geological Survey

Fuels Branch  
Northington Campus, University of Alabama  
University, Alabama

U. S. Geological Survey

Ground Water Branch  
Building 6  
University, Alabama

U. S. Army Corps of Engineers

(Mobile District Office)  
2301 Grant St., Box 1169  
Mobile 7, Alabama

MAPS:

"Geologic map of Alabama," by Alabama Geological Survey,  
scale - 1:500,000, 1926

BIBLIOGRAPHIES:

"Bibliography of Alabama geology," E. L. Hastings, Alabama Geological Survey Bulletin 67. This publication, along with Bulletin 47 of the Alabama Geological Survey, gives a complete bibliography of Alabama's geology through 1958.

OTHERS:

Alabama Geological Survey Library, Mrs. Betty Thomas, Librarian.  
This library contains extensive holdings of Alabama geology.

## BEDROCK - BY STATES

### ALABAMA

#### ROCK TYPE - GEOLOGICAL CLASSIFICATION

##### MAPS:

1. "Geologic map of Alabama," by Alabama Geological Survey, scale - 1:500,000, 1926. Legend gives columnar sections for Cenozoic, Mesozoic, and Paleozoic. Representative thickness of units and characteristic lithology are shown.
2. "Geologic index map of Alabama," by L. Boardman and E. Watson, U. S. Geological Survey, 1951. Outlines areas covered by geologic mapping and references each map or report cited.

Note: Best map coverage is in the central and east central parts of the state (east and northeast of Tuscaloosa). Scales range from 1:38,000 to 1:1,280,000.

3. County geologic maps in progress include the following:

Autauga	Etowah	Marengo
Bulllock	Franklin	Morgan
Cahoun	Hale	Pickens
Colbert	Lauderdale	St. Clair
Escambia	Limestone	Tuscaloosa

##### SECTIONS:

1. State geologic map (cited above). Shows lithology and folding along four structure sections which cross the map at various trends.
2. Larger scale sections for selected areas are contained in specific reports by the Alabama Geological Survey and by the U. S. Geological Survey (Bulletins and Water Supply Papers). Sections related to field trips published by the Southeastern Geological Society, Box 841, Tallahassee, Fla.

##### SUBSURFACE:

1. The Alabama Geological Survey has extensive files of unpublished graphic and descriptive logs from oil and water wells. Consult Mr. Charles Copeland.

#### ROCK TYPE - ENGINEERING GEOLOGICAL CLASSIFICATION

##### MAPS:

1. No state map available. Large-scale maps of selected sites available from the U. S. Army Engineer District, Mobile. Additional data available from the Bureau of Materials and Research, Alabama State Highway Department. Contact Mr. Donald Palmore, Montgomery office.

## BEDROCK - BY STATES ALABAMA

### ROCK TYPE - ENGINEERING GEOLOGICAL CLASSIFICATION

#### FOUNDATION ENGINEERING FIRMS:

1. R. E. Strickland and Associates  
701 South 37th Street  
Birmingham, Alabama  
Area Code: 205, AL 1-5239
2. Law Engineering Testing Co.  
2920 Seventh Avenue South  
Birmingham, Alabama  
Area Code: 205, AL 1-5408

### CHEMICAL AND MINERALOGICAL COMPOSITION

#### AGENCIES:

1. Geological Survey of Alabama  
P. O. Drawer "O"  
University, Alabama  
Holds basic information and is conducting research on iron ore,  
rocks and minerals of Alabama, mineral resources for use as  
lightweight concrete aggregate, etc.
2. U. S. Bureau of Mines  
Southern Experiment Station  
P. O. Box "L"  
Tuscaloosa, Alabama

#### HANDBOOKS AND REFERENCES:

1. "Symposium on mineral resources of the southeastern United States,"  
University of Tennessee Press, 1950.

### WEATHERING CHARACTERISTICS

#### AGENCIES:

1. See information at national level.
2. For Alabama, consult Geological Survey of Alabama, U. S.  
Geological Survey, and U. S. Army Corps of Engineers.

#### REFERENCES:

1. "Description and origin of stone layers in soils," by E. J. Parizek.  
Journal of Geology, vol. 65, No. 1, pp. 24-34, 1957.

**BEDROCK - BY STATES****ALABAMA****PHYSICAL PROPERTIES****AGENCIES:**

1. U. S. Army Engineer District, Mobile  
(Cited above)  
Strength properties and deformation characteristics
2. Geological Survey of Alabama  
U. S. Geological Survey  
(Cited above)  
Structural fabric, porosity, and permeability

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# CLIMATE

## CLIMATE - NATIONAL

### GENERAL

#### AGENCIES:

1. U. S. Weather Bureau, Department of Commerce  
24th at M Street, N.W.  
Washington 25, D. C.  
*F. W. Reichelderfer, Chief*  
Area Code: 202, 965-2400, Federal Code: 191

Bureau consists of:

Central Office  
Office of Meteorological Research  
Office of Climatology  
Hydrologic Services Division  
Instrumental Engineering Division  
Observations and Station Facilities Division  
National Meteorological Center

Telephone and personal requests for general technical information can be made to any U. S. Weather Bureau field station or the U. S. Weather Bureau Central Office in Washington, D. C. Mail requests should be addressed to: Chief, U. S. Weather Bureau, Washington 25, D. C. All inquiries concerning active or completed U. S. Weather Bureau research projects should be addressed to: Director, Meteorological Research, U. S. Weather Bureau, Washington 25, D. C.

The U. S. Weather Bureau Library maintains a personnel list of subject specialists who are equipped to provide detailed information on their respective areas of research.

The U. S. Weather Bureau's research and development programs produce scientific and technical information in the following categories:

- (a) Meteorology: Synoptic and dynamic meteorology, upper atmosphere research, atmospheric and solar radiation, micrometeorology, mesometeorology, meteorological statistics, polar research, atmospheric circulation, air pollution, and oceanographic meteorology
- (b) Physics of the atmosphere: Physics of precipitation, cloud particles, atmospheric electricity and acoustics
- (c) Climatology: Synoptic climatology, upper atmosphere climatology, bioclimatology, climatic trends, statistical climatology, and microclimatology
- (d) Hydrology: Hydrometeorology; river stages; and flood, river, and water-supply forecasting
- (e) Weather forecasting: Numerical prediction, short-range forecasting, extended-range forecasting, and severe storm forecasting
- (f) Instrument engineering: Engineering development of weather instruments, meteorological satellites

---

Office of Climatology  
Federal Office Bldg. No. 4  
Suitland, Maryland  
*Dr. Helmut E. Landsberg, Director*  
Area Code: 202, REpublic 5-2000, Ext. 7287  
Includes: Climatologic Investigations Branch, Climatic Field Service Branch, Climatic Advisory Service Branch, and the National Weather Records Center.

## CLIMATE - NATIONAL

### GENERAL

#### AGENCIES (Con't):

##### 1. U. S. Weather Bureau (Con't)

National Weather Records Center

Asheville, North Carolina

*Dr. Gerald Hareer*, Director

Area Code: 704, \_\_\_\_\_

The center is the principal statistical center and archive for weather records.

The United States is divided into six areas, each under the responsibility of an Area Climatologist. Climatologists are also located in most states and territories.

##### 2. Air Weather Service, U. S. Air Force

Climatic Center

Annex 2, 225 D Street, S.E.

Washington 25, D. C.

*Lt. Col. G. E. Maxon*, Director

Area Code: 202, STerling 3-5200, Ext. 351

Air Force weather records are incorporated in the National Weather Records Center at Asheville, North Carolina.

#### PUBLICATIONS:

##### 1. "Scientific information activities of Federal agencies, U. S. Weather Bureau," National Science Foundation, Publication No. NSF 60-58, Washington, 1960.

The U. S. Weather Bureau publications are arranged in five types:  
Research Publications, Technical Publications, Climatological Publications, Training Publications, and Miscellaneous. The Climatological Publications include the following summaries:

1. "Monthly and annual national summary of climatological data." Includes surface, storm, flood, upper air, solar radiation, temperature, and precipitation data.
2. "Climatography of the United States." Decennial census of U. S. climate (hourly observations) and other summarized climatological data. Published irregularly since 1955.
3. "Monthly and annual state summaries of climatological data." Includes tabulations on temperature, precipitation, evaporation, and wind. In some cases, data are included on soil temperature, snowfall, and snow accumulation.
4. Local summaries of climatological data are published monthly and annually for several thousand stations in the United States. Tabulations include temperature, precipitation, wind, sunshine, sky cover, and summary of hourly observations.

## CLIMATE - NATIONAL GENERAL

### PUBLICATIONS (Con't):

5. "Hurricane packages." Special publications including extensive data on severe storms.
6. Miscellaneous:
  - (a) "U. S. Weather Bureau synoptic weather maps for the northern hemisphere."
  - (b) "U. S. Weather Bureau rainfall frequency map," scale - 1:10,000,000. For durations from 30 minutes to 24 hours and return periods from 1 to 100 years.
  - (c) "Sheet of the national atlas of the United States," scale - 1:10,000,000. Mean data of first 32° F temperature in autumn.
  - (d) A series of 49 rainfall frequency maps of the United States, scale - 1:10,000,000. Durations from 30 minutes to 24 hours and return periods from 1 to 100 years. In publication.

### HANDBOOKS AND REFERENCES:

1. The following periodicals are the primary sources of technical articles in all aspects of climatology:

Bulletin of the American Meteorological Society  
Journal of Meteorology  
Journal of Geophysical Research  
Tellus  
Review of Scientific Instruments  
Journal of Atmospheric and Terrestrial Physics
2. "Meteorological and geoastrophysical abstracts," published monthly by the American Meteorological Society.
3. Various technical papers published by the U. S. Weather Bureau, i. e. "Rainfall frequency atlas of the United States," by D. M. Hershfield, U. S. Weather Bureau, Technical Paper No. 40, 1960.
4. "Climatology at work," by G. L. Barger. U. S. Weather Bureau, Washington, 1960.

### INDIVIDUAL AUTHORITIES:

1. *Prof. Phil E. Church*, Chairman  
Department of Meteorology and Climatology  
University of Washington  
Seattle, Washington
2. *Prof. Ried A. Bryson*, Chairman  
Department of Meteorology  
University of Wisconsin  
Madison, Wisconsin

## CLIMATE - NATIONAL GENERAL

### INDIVIDUAL AUTHORITIES (Con't):

3. *Prof. J. E. Miller*, Chairman  
Department of Meteorology and Oceanography  
New York University  
New York, New York
4. *Prof. D. F. Leipper*, Chairman  
Department of Oceanography and Meteorology  
Texas A & M College  
College Station, Texas
5. *Prof. W. LeRoy Decker*  
Atmospheric Science Department  
University of Missouri  
Columbia, Missouri
6. *Mr. Arno R. Kussander*, Director  
Institute of Atmospheric Physics  
University of Arizona  
Tucson, Ariz.

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Bureau of Land Management, U. S.	
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California Department of Highways	
California Division of Forestry	
California Division of Mines	
California Water Resources Division	
Carnegie Institution of Geophysics	
Coast and Geodetic Survey, U. S.	
Cold Regions Research & Engineering Laboratory, U. S. Army	
Colorado Water Conservation Department	
Connecticut Geological and Natural History Survey	
Connecticut State Department of Water Resources	
Connecticut State Highway Department	
Connecticut State Park & Forest Commission	
Corps of Engineers, U. S. Army	

**APPENDIX D: EXAMPLE OF ENGINEERING-GEOLOGIC MAP FOLIO**

## APPENDIX D: EXAMPLE OF ENGINEERING-GEOLOGIC MAP FOLIO

Introduction

1. The engineering-geologic map folio developed in this study is specifically designed to assist in the solution of the site selection and construction problems that will be encountered in a large-scale shelter program. As an example of the involved mapping technique and the format considered most suitable, a folio covering part of the city of New Orleans, Louisiana, was prepared and is contained in the pocket attached to the back cover of this report. The folio and its accompanying descriptive material present and evaluate the significance of various environmental factors with respect to shelter problems principally in terms of architectural engineering. Because it is assumed that many, if not all, shelters will be located underground, particular attention has been given to the environmental factors that affect foundation design and placement.

2. The map folio developed is intended for implementation only in large metropolitan or urbanized areas. Such areas have the highest population densities, and thus have a greater need for shelter spaces per unit area than elsewhere. Also, only for large cities and urbanized areas is there generally a sufficient amount of available data regarding soils, bedrock, water-table conditions, and other engineering-geologic factors to permit adequate map presentation.

3. The optimum map scale for use in the presentation of environmental data in urbanized areas is considered to be either 1:24,000 or 1:25,000. The most complete coverage of the larger cities in the United States (estimated at about 75 percent) by topographic maps is in the form of the 1:24,000-scale sheets prepared by the U. S. Geological Survey, and the 1:25,000-scale sheets prepared by the U. S. Army Map Service. Various smaller scale maps were evaluated for use in the mapping program, and were found to be wholly inadequate.

Explanation of Mapping Technique

4. The four environmental factors which form the basis of the

mapping technique used to produce the attached map folio are: (a) the engineering classification of the soil cover, (b) the engineering classification of the bedrock, (c) the thickness of the soil cover or the depth to the bedrock, and (d) the depth to the water table.

5. In the example map folio of a portion of the New Orleans, Louisiana, area, the soil cover is mapped to an arbitrarily selected depth of 30 ft. Since all of the soils are depositional, the classification is based on environments of deposition. Each environment of deposition contains one or more engineering soil types, according to the Unified Soil Classification System.\* Differences in the areal distribution of the environments of deposition or significantly differing combinations of environments of deposition constitute the bases for map units. Each map unit is designated by a color or color pattern on the quadrangle map in the example folio.

6. Although environments of deposition would be an inappropriate classification for the soil cover in many areas, there are numerous other classification systems or methods of division which could be used. Subdivision of the area under consideration into map units should be possible using almost any type of classification.

7. No true bedrock is encountered at shallow depths (< 100 ft) in the New Orleans area. However, to illustrate how a bedrock surface can be represented by contours, a near-surface formation has been contoured on the example map. From the standpoint of foundation design, the contoured formation actually is a quasi-bedrock surface.

8. In those areas where bedrock is present, it should be differentiated into its component rock types wherever this is applicable (e.g. granite and sandstone). The choice of a technique for representing the rock types on the map largely will depend on the number and the areal distribution of the rock types. In cases where various rock types occur at depths less than 30 ft, they should constitute the bases for creating map units. For example, an area characterized by 15 to 20 ft of sand overlying

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\* Military Standard MIL-STD-619A (CE), Unified Soil Classification System for Roads, Airfields, Embankments and Foundations, 20 March 1962.

granite should be included in a different map unit than an area characterized by 15 to 20 ft of sand overlying shale.

9. The depth to the groundwater table in the New Orleans area is indicated on the example map by a series of spot elevations. Each elevation was obtained from soil borings which were made at various times during the past 20 years. The relative uniformity of the water table throughout the area and the limited number of elevations prevented the contouring of the groundwater surface. Contouring of the groundwater surface is considered advisable wherever the data permit, particularly in those areas where there are significant areal or seasonal variations in level.

10. The textual data contained in the map folio include discussions of two important aspects of groundwater, i.e. the possibility of excess hydrostatic pressures, and the chemical quality. In certain respects, these may be considered as special factors that are unique to the New Orleans area. It is important to note, however, that special factors similar to those mentioned above are likely to occur in most areas. If they are of significant importance from the standpoint of engineering, they should be discussed in the folio or portrayed on the map, or both. The greatest value will be derived if they can be described or portrayed in quantitative terms.

11. The occurrence of extensive zones of peat and highly organic clay is a highly significant factor in the New Orleans area. Large quantities of subsurface data have made it possible to illustrate the thickness of these deposits by means of isopachs (lines showing equal thickness). These serve to illustrate how another special factor of interest in a particular area can be included in a map folio.

12. Actually there is almost no limit to the number of special factors that could be presented in the map folios. According to the suggested format, each factor is presented in such a way as to be independent of other factors, i.e. one is not a prerequisite for another. Care should be exerted in all cases, however, to insure that an excessive amount of data is not presented on the map. Selection and mapping of only a few of the more significant factors will be necessary in many areas to avoid detracting from the basic factors.

13. The subdivisions of the table giving the engineering

characteristics of the soils encountered in the New Orleans area should be applicable to any areas that might be mapped. Likewise, a table indicating how the various environmental factors would interrelate to affect the design and construction of various types of shelters would be applicable. The effectiveness of this table should improve in the future as more data become available concerning acceptable designs for actual shelter types. Perhaps at that time, the emphasis of the data in the table could be directed more toward the actual suitability of various areas for the utilization of a shelter type or types.

14. The presentation of nonenvironmental data in the map folio is not and should not be excluded. In the example folio, the locations of the existing fallout shelters are included on a transparent overlay. A list of other information that might be of value in shelter site selection or construction would include such items as locations of potential building sites for shelters, locations of existing communication facilities, and the distribution of potential or existing evacuation routes. Data presented on overlays have the advantage of being readily subject to amendment or revision.

15. The sources of much additional information and more specific data concerning the engineering geology of the mapped area can be obtained by referring to the list of references included in the folio. This list is supplemented by an equally important listing of repository agencies for borings, soils reports, and similar data, and also a list of the foundation engineering firms that have conducted projects in the area. Lists of these types certainly warrant the relatively small amount of time necessary for their preparation.

APPENDIX E: DETAILED RESEARCH DESIGNS AND COST ESTIMATES  
FOR RECOMMENDED COURSES OF ACTION

APPENDIX E: DETAILED RESEARCH DESIGNS AND COST ESTIMATES  
FOR RECOMMENDED COURSES OF ACTION

1. This appendix contains the research designs and cost estimates for the preparation of a directory of environmental data sources, and a pilot program for the preparation of engineering-geologic map folios for selected urban complexes.

Environmental Data Source Directory

Degree of detail

2. Selection of the degree of detail required in the directory is the fundamental controlling factor in working out its research design and cost estimate. Inasmuch as the recommendation for preparation of the directory (paragraph 66 in main text) specifies that the Staff Coordinator for Environmental Data should be responsible for determining (a) the need for preparation of the directory, and (b) the degree of detail required for optimum coverage, the development of a highly detailed research design at the present time is not feasible. On the other hand, the hierarchical character of the envisioned directory lends itself to a preliminary evaluation in terms of three orders of detail. The research design for all three orders consists of the same basic steps; considerable variation exists, however, in the degree of elaborateness involved in some of the steps for the three different cases. Cost estimates are presented for each of the three orders of detail.

3. The three orders considered here include: (a) generalized or first-order directory, (b) moderately detailed or first- and second-order directory, and (c) highly detailed or first-, second-, and third-order directory. As apparent, these are merely three arbitrarily defined entities selected from a continuous intergradational series. Other intermediate levels could also be established. The examples cited, however, are adequate for developing a preliminary research design and cost estimate.

4. At the generalized or first-order level, only the three or four principal national agency data sources would be listed for each of the thirteen data categories. Addresses and phone numbers of key personnel in

each agency would be given. The various divisions or branches of the agency would be named, but neither their exact location nor the names, addresses, and phone numbers of key personnel at that level would be listed. Specialists outside these agencies would not be listed, nor would such materials as handbooks, bibliographies, maps, etc. If a directory average of one to two pages per agency, and four agencies per category is assumed, such a directory would probably total 75 to 100 pages, and would probably cost about \$15,000 to compile and print.

5. At the moderately detailed or first- and second-order level, the information contained in the directory would also include: principal subdivisions of the basic data categories with the name, address, and telephone number data for the pertinent branches and units of the appropriate major national agencies, additional secondary national agency sources, and a listing of appropriate major state agencies. A directory of this type would probably total 400 to 600 pages, and would cost about \$30,000 to produce.

6. At the highly detailed or first-, second-, and third-order level (see example in Appendix C), the directory would also contain listings of other data sources such as: universities, libraries, handbooks, bibliographies, maps, basic published references, and individual authorities pertinent to each category and subcategory. It would also contain expanded sections for individual states. In addition, annotations delineating subject matter, format, degree of detail, geographic coverage, etc., would be included for the majority of the sources listed. A directory of this type would probably total well over 1200 pages, and would cost at least \$70,000 to produce.

#### Basic concept

7. The basic concept underlying the use of the directory requires the user to consult the information category or subcategory that is appropriate to his problem, and to select the seemingly pertinent information sources. The user would then contact the sources directly. In most cases, the initial contact would probably be made by telephone. As apparent, by increasing the degree of detail contained in the directory, the number of calls required to locate the proper office or individual to answer a given question can be reduced appreciably. On the other hand, increasing the

contained detail increases the cost of preparation and the need for periodic revision to insure accuracy. Quite obviously, a balance exists between cost of preparation and cost of use. This balance point is dependent upon the overall need for environmental data by OCD in-house and contract research personnel. As presented in Part VI (paragraph 63), it should be the responsibility of the Staff Coordinator for Environmental Data for the OCD to decide this question.

8. It should be noted, however, that the experience of the National Register of Scientific and Technical Personnel Agency, which has prepared a somewhat similar directory, indicates that the average user generally does not make more than a very limited use of the information contained in the directory before him. Rather, he telephones the first likely source that he finds in the directory and requests directions as to where to proceed next. Accordingly, Dr. Milton Levine, Director of the Register, forcefully recommends inclusion of only first-order, or at most, first- and second-order detail in such a directory. He emphasized that the increase in the degree of detail quickly reaches the point of diminishing returns. For these reasons, one of the principal responsibilities of the OCD staff coordinator should be the determination of just what degree of detail is actually necessary and practical.

#### Research design

9. The research plan for the preparation of a directory involves the following four steps: (a) collection of basic data, (b) compilation and evaluation of data, (c) design of format, and (d) printing. The elaborateness of steps (a) and (b) would vary considerably, depending upon the level of detail selected; steps (c) and (d), however, do not vary appreciably for the different levels of detail. The following discussions apply primarily to the highly detailed type of directory. Proportionately less elaborate steps are necessary for the other two types.

#### Collection of basic data

10. For the highly detailed (first-, second-, and third-order) directory, the data collection program would require a thorough nationwide census of potential data sources. This census would include: (a) wide circulation of a questionnaire, (b) a literature search, (c) a search of key information centers (such as the Scientific Information Exchange), and

(d) consultation with recognized specialists in each pertinent scientific field.

11. The questionnaire presumably would be sent to virtually every likely Federal and state agency, university, and private research organization. It might also be sent to commercial organizations, but such a program would raise a variety of serious problems. Probably the most immediate problem would be the vast number of such organizations involved. On the basis of preliminary estimates, logical recipients total about 1200, exclusive of commercial organizations.

12. The actual design of the questionnaire will require considerable effort, supported as necessary by appropriate professional consultants. Proper selection of the topics to be covered and the manner in which questions are worded are critical to the success of the questionnaire program. In addition, because the basic data will probably also be compiled on a punch card master for OCD in-house retention, the questionnaire design must be built around a compatible numerical base.

13. Because most questionnaires elicit only partial returns, an essential part of the questionnaire census program would be an effective "reminder letter-telephone call-visit" follow-up system to insure the receipt of an adequate volume of information.

Compilation and evaluation

14. Compilation of the large volumes of data required for the highly detailed directory will necessitate a carefully prepared processing and recording system. In addition, the evaluation of the compiled data to insure adequacy of coverage should be made by competent specialists in each pertinent scientific field.

Cost estimate

15. Cost estimates for the preparation of data source directories at the three successive levels of detail follow. Because of the uncertainties inherent in many of the items included, the sums specified should be considered as minima. Costs may run appreciably higher.

a. Highly detailed (first-, second-, and third-order) directory

Data collection

(1) Questionnaire

Formulation of questionnaire	\$ 5,000.00
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E5 E5

Compilation of addresses	\$ 1,000.00
Printing, addressing, and mailing	2,000.00
Follow-up system	10,000.00

(2) Information center queries	500.00
--------------------------------	--------

(3) Literature search	2,000.00
-----------------------	----------

(4) Travel for consultation with specialists in selected scientific fields	4,000.00
---	----------

<b>Subtotal</b>	<b>\$24,500.00</b>
-----------------	--------------------

Compilation and evaluation

(1) Compilation	\$20,000.00
-----------------	-------------

(2) Conversion to punch cards	2,000.00
-------------------------------	----------

(3) Evaluation of coverage by competent scientists	5,000.00
---	----------

<b>Subtotal</b>	<b>\$27,000.00</b>
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<u>Design of format</u>	\$ 3,000.00
-------------------------	-------------

Printing

Note: Cost will vary as a function of  
format, type style, quality of  
paper, type of binding, and  
number of copies

\$15,000.00
-------------

<b>Total</b>	<b>\$69,500.00</b>
--------------	--------------------

b. Moderately detailed (first- and second-order) directory  
(The following cost estimate assumes that level of effort  
would be roughly one-third of that required for highly de-  
tailed directory.)

Data collection

Note: Only very limited  
distribution of ques-  
tionnaire would be used \$ 8,000.00 to \$10,000.00

Compilation and evaluation 10,000.00 to 12,000.00

Design of format 1,000.00 to 1,500.00

Printing 5,000.00 to 7,000.00

<b>Total</b>	<b>\$24,000.00 to \$30,500.00</b>
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c. Generalized (first-order) directory

Data collection

Note: No questionnaire	\$ 5,000.00
------------------------	-------------

<u>Compilation and evaluation</u>	\$ 7,000.00
<u>Design of format</u>	500.00
<u>Printing</u>	2,000.00
<b>Total</b>	<b>\$14,500.00</b>

Engineering-Geologic Map Folio

16. The recommended course of action for preparation of engineering-geologic map folios is a pilot program to be carried out in three large urban areas. The objectives of the pilot program would be to: (a) test the validity of the general format of the map folio, (b) provide an indication of what types of special factors of local importance should be added to the folio, (c) evaluate the relative efficiency of various individuals, private concerns, or state and Federal agencies in conducting a mapping program, (d) permit the development of a reasonably accurate cost estimate for a large-scale mapping program, and (e) indicate the type and level of cooperative financing that could be obtained in a large-scale program.

Research design

17. The research plan for implementation of a pilot program involves the following three major steps: (a) initiation of the program in three cities, (b) development of the map folios, and (c) investigation of potential local interest.

18. The criteria to be used in the selection of the three cities are listed in paragraph 72 of main text. Once a decision on the cities has been reached, the next step in the pilot program would be the selection of competent individuals or groups to conduct the actual mapping and folio preparation under contract. Potential contractors can be grouped into two classes. The first includes the large Federal organizations, such as the U. S. Geological Survey and the U. S. Army Corps of Engineers, that have primary national responsibility for work of this type. These groups have the organizational structure and the overall capability for performing such a program, but do not necessarily have individuals who are familiar with the city in question or with immediate access to the bulk of the raw data required. The second class includes individuals or small groups at a local

level who would have the requisite familiarity with the city in question, and for at least some cases, easier access to pertinent data. State geological surveys and members of the engineering and geology staffs of universities would fall within this class. Since appreciable differences in the quality and cost of the product would likely occur, depending upon the individuals or groups involved, it is recommended that representatives of more than one of the classes mentioned in this paragraph be used to prepare the map folios. This would permit a careful evaluation of the cost-quality ratio.

19. In the actual preparation of the folios, it is recommended that complete map coverage of each city be accomplished. This will permit the derivation of a detailed cost estimate, and also negate any further consideration of the three cities involved.

20. During the preparation of the folios, some attention should be devoted to increasing their scope or effectiveness through the addition of supplemental data. Suggestions concerning how this might be done are included in paragraphs 10 through 12 in Appendix D. For uniformity of product, however, the basic factors should not be changed.

21. The final step in the pilot program will be to determine how much local interest could be developed in the folio. It is suggested that this might be accomplished by circulating printed copies of the map folios to state agencies and governments, local engineering firms, and municipal or regional planning commissions throughout the United States. In all probability, the wider the circulation, the greater will be the possibility for obtaining cooperative funding.

#### Cost estimate

22. Had the map folio contained in Appendix D of this report been prepared in a manner similar to that to be used in a pilot program, i.e. based on an already established format, it is estimated that it would have involved two to three man-months work by an experienced engineering geologist at an estimated cost of about \$4000 to \$6000. Although six quadrangles would be needed to cover the New Orleans area, the total cost would not be six times greater than the cost of preparing the one quadrangle presented in the folio. The descriptive materials in the folio would not have to be prepared for each additional quadrangle. Thus, the total cost

for a 6-quadrangle folio would be about \$15,000 to \$20,000.

23. The figures quoted above should be applicable to the folios that  
would be prepared in a pilot program. However, it is not possible to make  
an accurate estimate of how much the first and third steps in the program  
would cost, i.e. initiation of the program and investigation of potential  
local interest. Therefore, it can only be stated at this time that the  
total cost of the pilot program will probably be on the order of \$100,000  
to \$150,000.

**U. S. Army Engineer Waterways Experiment Station, CR, Vicksburg, Miss.** ORGANIZATION AND PRESENTATION OF ENVIRONMENTAL DATA FOR OFFICE OF CIVIL DEFENSE USE; A Feasibility Study by D. D. Smith and R. T. Saucier. April 1963, VIII, 29 pp and 5 appendices - tables. (Technical Report No. 5-62)

A nationwide appraisal of the status of the environmental data held by major Federal and state agencies indicates that voluminous unpublished data in various stages of processing exist for all pertinent categories of information. The fulfillment of data requirements for the Office of Civil Defense (OCD) depends upon the establishment of an effective information system which will facilitate communication and transfer of information from data sources to user. The three-part information system which appears most feasible for OCD use and which is recommended consists of: (a) a small in-house information center headed by a Staff Coordinator for Environmental Data, (b) a Board of Expert Advisers, and (c) an annotated directory of major environmental data sources. An appraisal of various data presentation techniques indicates a need for consideration of large-scale map presentation of environmental data, and a pilot program for preparing engineering-geologic maps fundamental to fallout shelter construction in major U. S. cities is recommended.

**U. S. Army Engineer Waterways Experiment Station, CR, Vicksburg, Miss.** ORGANIZATION AND PRESENTATION OF ENVIRONMENTAL DATA FOR OFFICE OF CIVIL DEFENSE USE; A Feasibility Study by D. D. Smith and R. T. Saucier. April 1963, VIII, 29 pp and 5 appendices - tables. (Technical Report No. 5-62)

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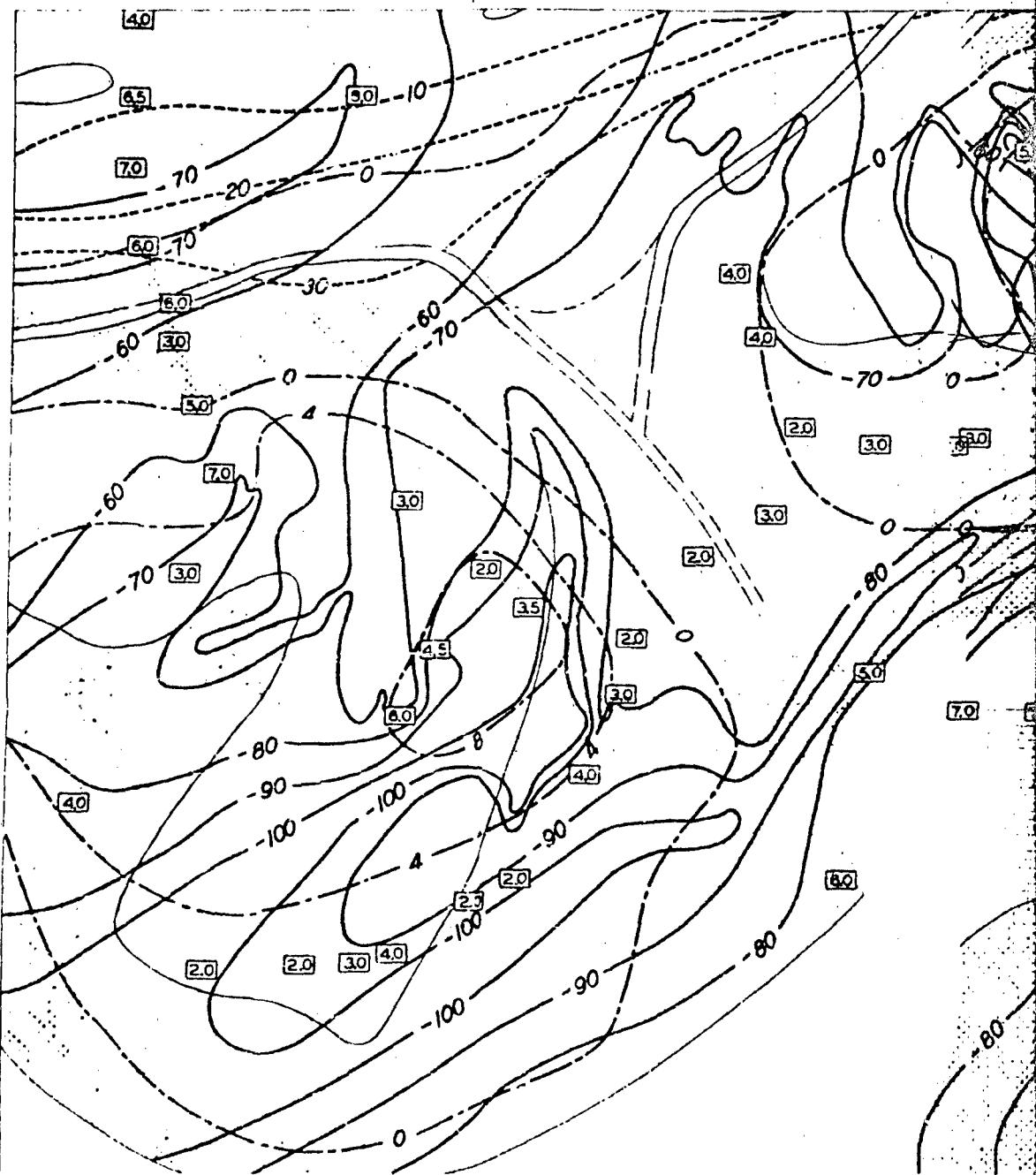
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Major U. S. cities is recommended.

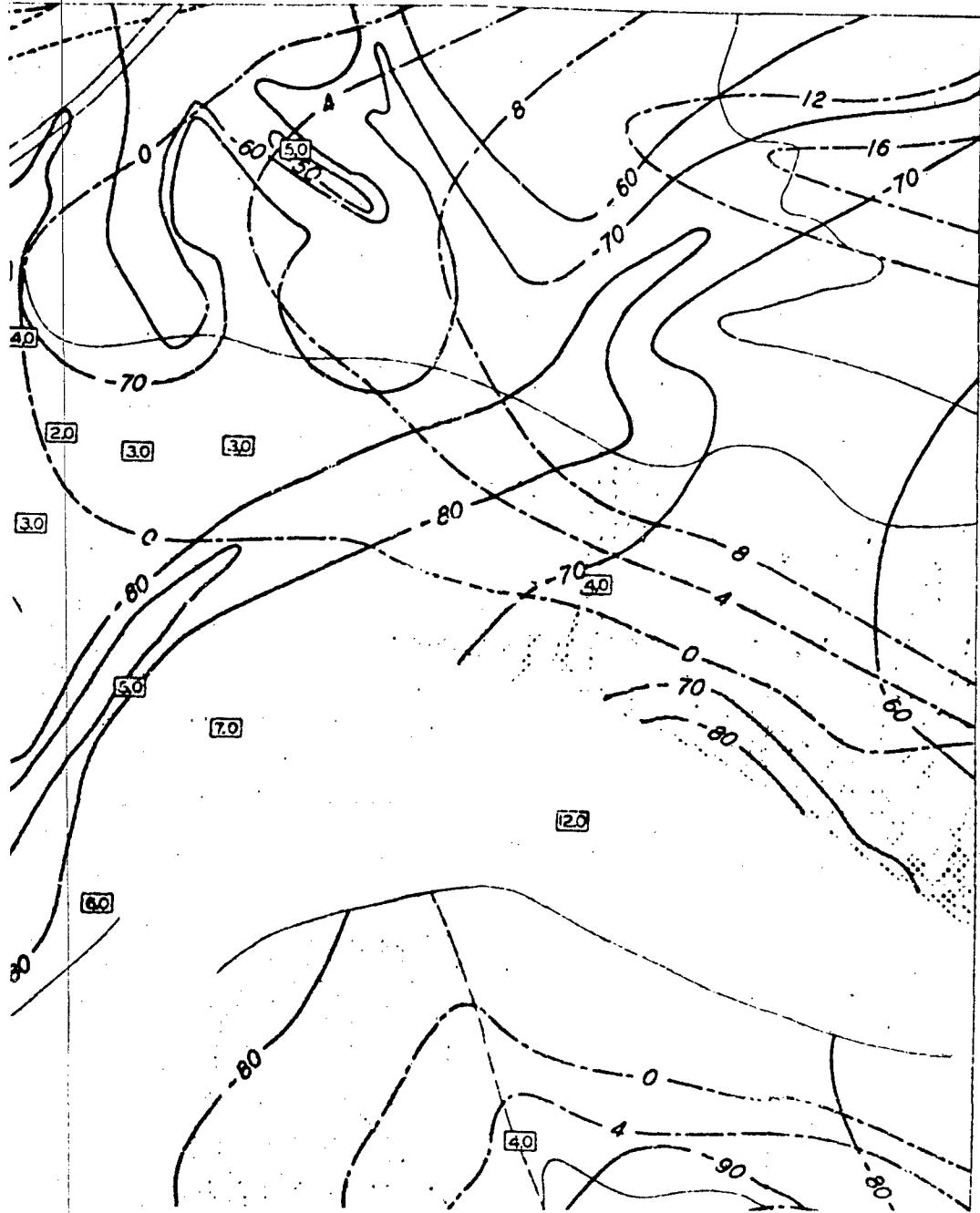
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in major U. S. cities is recommended.

for three

## NEW ORLEANS EAST, LSQH

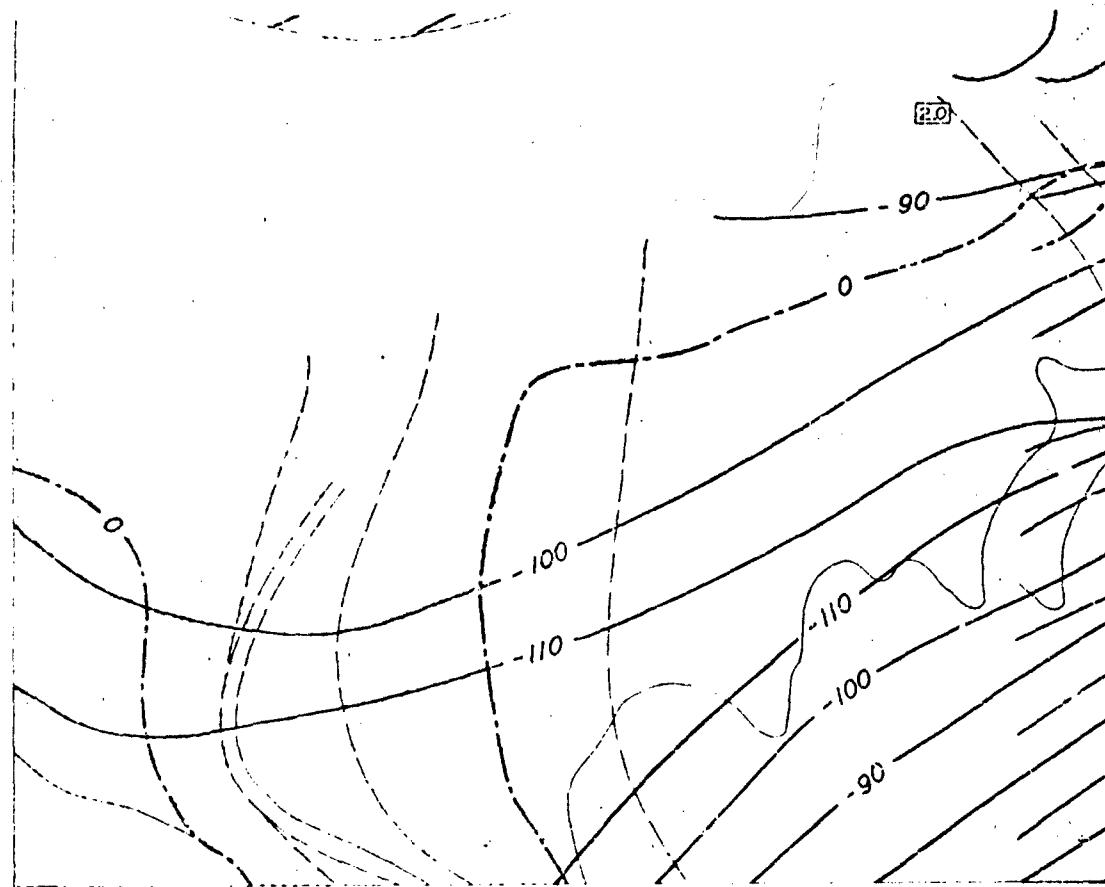


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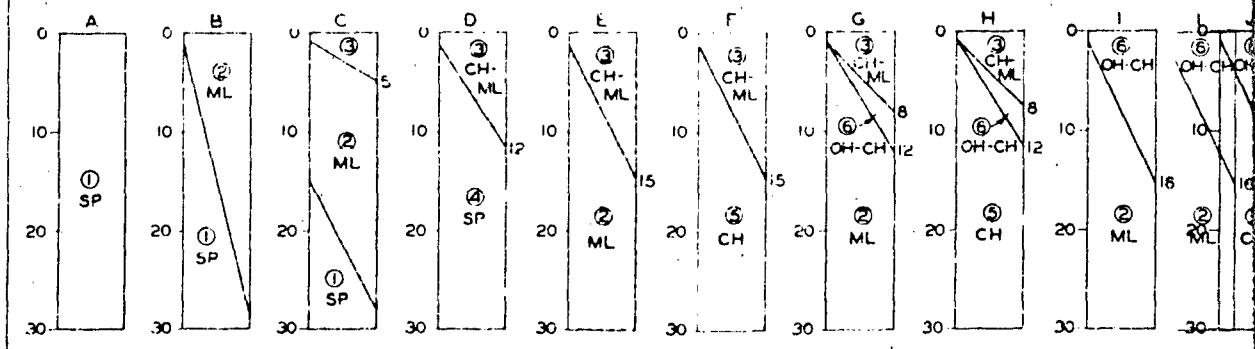


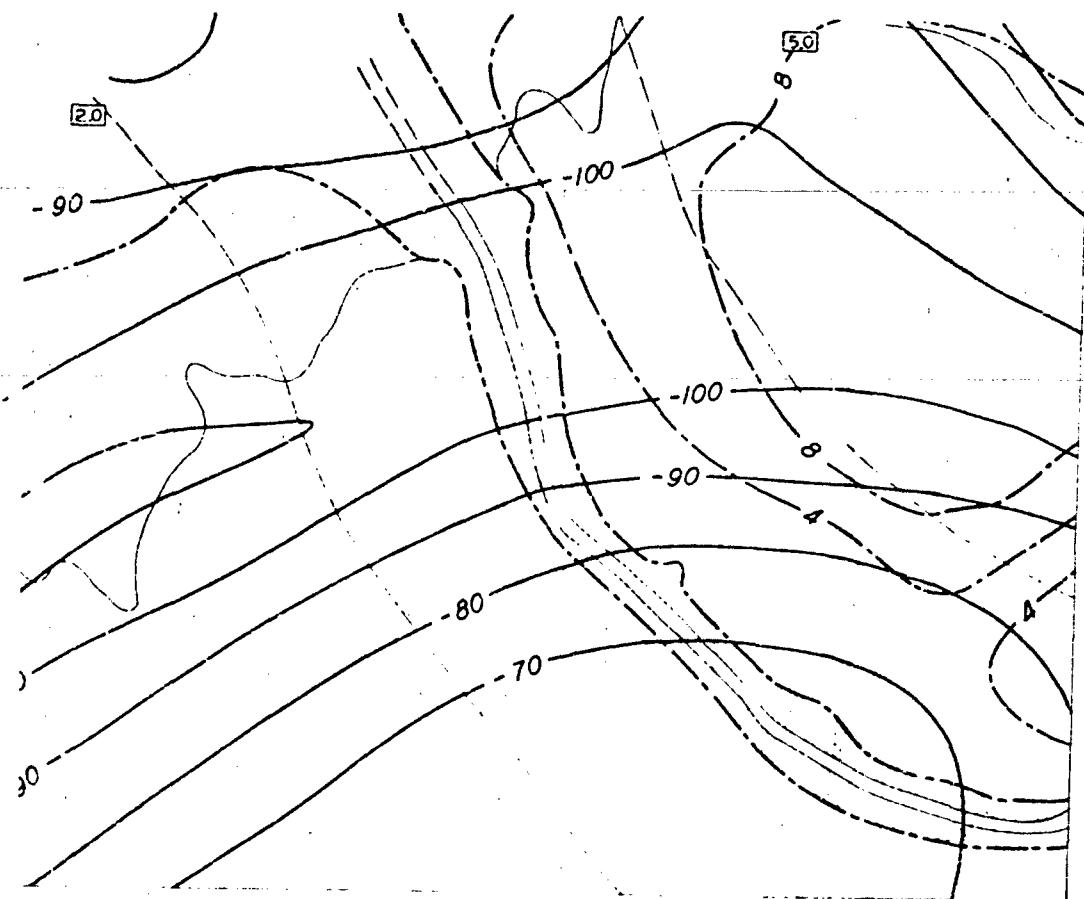
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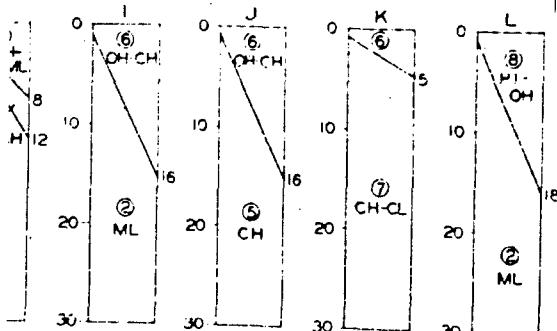
LEGENDS END





CONTOUR INTERVAL FEET  
50 FT

#### LEGEND



— -70—

— -0—

— -10—

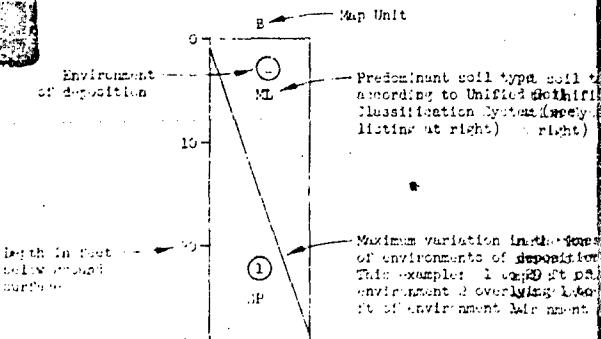
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Legend: Contour interval 50 ft. Dashed lines represent streamlines. Solid lines represent contour lines.

Legend: Contour interval 50 ft. Dashed lines represent streamlines. Solid lines represent contour lines.

Legend: Contour interval 50 ft. Dashed lines represent streamlines. Solid lines represent contour lines.

## EXPLANATION OF LEGEND



The near-surface formations in the New Orleans area have been mapped to an arbitrarily selected depth of 10 ft beneath the ground surface. Environments of deposition are the bases for division of the materials within this depth range. Each environment is characterized by a relatively distinct soil type or range of soil types. Differences in the areal distribution of the environments is significantly different from that of environments of deposition for map units. Designations of the unit and environments and an explanation of other notation are as follows:

### ENVIRONMENTS OF DEPOSITION

#### GENERAL

All of the near-surface deposits (0 to 10 ft) in the New Orleans area are buried and were deposited in a marine, marginal, coastal environment by the Mississippi River. None of the big cuts are 100 ft deep, may be referred to as gullies. No tide action is encountered within the limits of coastal construction; poorly consolidated materials occur to depths of at least several hundred feet.

Fairly simply interfingered environments are present in the coastal plain. Fluvial sediments are deposited principally in the tidal areas within and along streams and in fresh to brackish water. Tidal or fluvial material occurs, plain bay, and marine littoral, bay, etc. Fluvial grain sizes are fairly even in the majority of the areas. In general, coarse, sandy, silty, and silty-sandy materials are the most common environments, which include sand and silt as textures, and fine-grained materials, clays, in situ. The marine environment includes sand, silt, clay, loam, and peat deposited by the sea.

(1)

#### Environment of deposition: Beach

Method of deposition: Once characterized a shoreline of the Gulf of Mexico. Beach deposit is 3 to 5 miles wide, over 20 miles long, and 3 to 40 ft thick.

Textural groups: Approximately 90 percent poorly sorted fine to medium sand (SP), 5 percent silt (ML), and 5 percent sheet. Silt and sand are normally not localized in channel; rather they are mixed with the sand.

Organic content: Very low to none. Brown organic stain may be present where deposits are in contact with highly organic materials.

Water content: Saturated below the water table.

Angle of internal friction: 30 to 35 deg

(2)

#### Environment of deposition: Intradelta

Method of deposition: Intricately interfingered, relatively coarse deposits deposited in broad waves about abandoned courses and major distributaries. Thickness of deposits averages between 25 and 50 ft.

Textural groups: Intricately interfingered zones of fairly dense silt (ML) and silty sand (SP) with minor quantities of clay (CH and CL) in thin, dis-

#### (6)

#### Environment of deposition: Marsh and swamp (artificially drained)

Method of deposition: Formed in basin areas away from active river systems (in swamp). Areas characterized at long time evolution and preservation of plant debris. Materials never deposited as a result of artificial drainage.

Textural groups: 40% medium, poorly stratified sand/clay (ML), 10% sand (CL), and peat (Pt) with scattered white silt (SM). Silt are insufficient to permit a percentage breakdown. Material may be either charred or woody. Large pieces of wood or charred stamps may be encountered throughout the deposit.

Organic content: Including peat horizons, actual accumulation is not expressed in percent.

Water content: Data limited; values are probably between 15 and 30 percent.

(7)

#### Environment of deposition: Abandoned distributary, butary

Method of deposition: Ephemeral zones of fine-sorted materials abandoned distributaries. Zones vary in width from several yards or more and are from 10 to 50 ft thick. A downstream-trending larger material fills the base of the old channel.

Textural groups: In the upper portion, very soft to medium fine lean clays (CL) with scattered thin layers of silt (ML) and clay. The layers of silt and sand become more numerous with downward grade into a basal sand (SP) or silty sand (SM) wedge. No data exist to permit a percentage breakdown.

Organic content: Normally low. Scattered small particulate organic may be present in the upper portion of the unit.

Water content: Data limited, but values are probably high.

(8)

#### Environment of deposition: Marsh and swamp

Method of deposition: Essentially the same as in environment 6 except that organic accumulation is still progressing. Ground has been artificially drained.

Textural groups: Very soft humus and/or peat (Pt) varying from 10 to 30 percent. Clay and sand are minor components.

## ANATION OF LEGEND

### Map Unit

(1) Predominant soil type according to Unified Soil Classification System (see listing at right)

(2) Maximum variation in thickness of environments of soil units. This example shows a range of 100 ft. over much of the area.

(3) Major or minor surface by terrain.

(4) Land uses may vary from one place to another due to differences in topography and drainage patterns. These are representative uses.

(5) A single unit of soil may consist of two or more distinct parts, with different properties. This is particularly true of organic soils which may contain peat, humus, and/or mineral material.

(6) A surface may consist of two or more parts.

(7)

### Standized distributary

Wide zones of fine-grained soils, the fillings. These vary in width from several hundred to 1 to 2 ft. 10 ft thick. A downstream-thinning wedge of back of the old channel.

upper portion, very soft, to medium fat clays (CH) and thin layers of silt (ML) and silty sand (SM). They become more numerous with depth and eventually P or peaty soil (PM) wedge. Data are insufficient unknown.

low. Scattered small particles of organic matter a portion of the unit.

ed, but values are probably high.

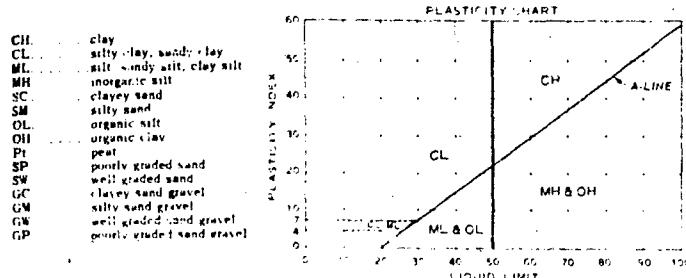
(8)

### Marsh and swamp

entilly the same as in environment of deposition & fallen in still processing. These areas have not

t humus and/or peat (PT) varying from several inches to several feet. It is often found in low-

### THE UNIFIED SOIL CLASSIFICATION SYSTEM



It can be seen from the chart that soils which would react unfavorably at site are those that have a plasticity sufficiently high to require the use of special types of cement. The clayey soils, particularly those containing organic material, in the area are of considerable potential for foundation failure. The organic soils, particularly those containing peat, are particularly susceptible to sulfate attack.

Probably in the area of the Mississippi River, was under pressure of great pressure, the soil became a marshy mud unit. Although the soil is not compressible, it is very soft and may move around easily. It may become firm again when dry. The pressure of the soil may cause it to settle, especially when not treated with lime. The soil may become extremely wet and/or hydrogen sulfide.

### PILE DRIVING

In most of the dredgeable deposits in the New Orleans area lack sufficient strength to support foundation piles must be utilized to transfer the loads to a stable foundation. It is at greater depth. If the structural loads are not too great, piles sometimes can be driven to sand units lying 40 to 70 ft below the surface. These sand units provide adequate pile support only if they are not underlain by compressible clays.

Where compressible clays are present, where the structural loads are great, piles must be driven into the deeper Pleistocene formation. The deposits in this formation have higher strengths than are present in any of the overlying Recent deposits. Probably over 75 percent of the piles used for large buildings, bridges, etc., in the area penetrate into Pleistocene deposits.

Pleistocene deposits typically consist of about 40 percent fat clay (CH), 25 percent lean clay (CL), 25 percent silt (ML) and silty sand (SM), and 10 percent sand (SP). Natural water contents vary from about 20 to 80 percent dry weight for fat clays (CH) and 15 to 60 percent for lean clays (CL). Cohesive strengths for fat clays vary from about 400 to over 3000 lb per sq ft and for lean clays from 300 to about 2500 lb per sq ft.

The contours on the enclosed map indicate the general depth to the surface of the Pleistocene formation. Since the contour used in contouring the surface is poor in many cases and since there is both lateral and vertical variability within the formation, the precise nature and occurrence of the formation at each site should be determined by borings. Moreover, borings will be necessary to determine how far into the deposits piles will have to be driven to obtain the necessary resistance.

### CONSTRUCTION MATERIALS

continuous lenses. Considered as a unit, intradelta deposits consist of up to 4 percent silt, 10 percent sand, and 85 percent clay. These deposits usually grade laterally into and interfinger with the predominantly clayey interdistributary deposits.

Organic content: Usually quite low. A few small, widely disseminated patches may be present.

Water content: Varies from 30 to 60 percent dry weight for clays (CH) and from 40 to 70 percent for silts (SM) and sandy silts (SM).

#### (4) Interdistributary Deposits

Method of deposition: Lenses of interdistributary deposits, ranging in size from a few square miles to the Mississippi River and its numerous distributaries and associated canals. Lateral lateral and longitudinal distribution is due to silt of other channels, smaller in size than those along the Mississippi River.

Textural groups: 15 percent fine clay (CH), 1 percent lean clay (CL), 10 percent silt (SM), and 1 percent silty sand (SL). Silts are usually very fine-grained, and rarely very fine; sand, which is well rounded, is not particularly abundant. Xeroflora is usually well developed.

Organic content: Normally extremely low.

Water content: Basically the same as in organic deposits in the areas where sand is up to 40 percent dry weight.

Cohesive strength: Varies from about 100 to 150 lb per sq ft for the clay (CH) and from 100 to 150 lb per sq ft for the clay (CL).

#### (5)

#### Deltaic Deposits: Deltaic

Method of deposition: Formed at the mouth of the river, or in the pro-delta Mississippi River, and its associated channels and distributaries. Deposits frequently overlie older units along the pro-delta river.

Textural groups: Mixtures of about 15 percent fine clay (CH), 1 percent lean clay (CL), 10 percent silt (SM), 10 percent silty sand (SM), and 1 percent sand (SP). The percentages of clay and silt increase with depth.

Organic content: Normally quite low. Some organic clay (CH) may be present in shallow swales at or near the surface of the deposits.

Water content: Varies from 30 to 60 percent dry weight for clays and 30 to 50 percent for silts.

Angle of internal friction: 25 to 35 deg for clay (CH).

#### (5)

#### Environment of deposition: Interdistributary

Method of deposition: Formed as clay wedges between major distributaries. Clay sequence interrupted by silty or sandy materials associated with myriad small distributaries. Thickness similar to intradelta deposits.

Textural groups: About 80 percent very soft to medium fat clays (CH), 10 percent silt (SM), and 10 percent lean clay (CL), silty sand (SM), and sand (SP). The silts and sand normally occur as thin partings between slightly thicker clay lenses.

Organic content: Very thin layers of finely divided particles or zones of moderately organic clay (CH) in the upper portions of the unit where there is usually gradation into overlying marsh or swamp deposits.

Water content: Varies from 50 to 100 percent dry weight for wet clays (CH) and from 70 to 120 percent for organic clays (CH).

Cohesive strength: Ranges between 100 and 450 lb per sq ft for fat clays. When organic matter is present, the strengths are considerably lower.



Method of deposition: Formed as a thin layer of organic material, usually thin (up to 3 in.) layers of silt (SM) or silty sand (SM). In marsh areas, a 6-in. to 12-in.-thick mat may develop. Marsh and land occur frequently, both above the deposits.

Organic content: Normally about 10 to 20 percent by volume, up to three times greater content than swamp deposits.

Water content: Highest of any in the area. The normal range is 70 to 100 percent dry weight.

Cohesive strength: No data available for marsh deposits. Between 100 and 300 lb per sq ft for organic clays in swamp.

## SPECIAL CONSIDERATIONS

Certain special conditions exist in the New Orleans area that consideration in nearly all types of construction. The conditions described below may occur in one or two of the major map units, others may be encountered throughout the area.

### PLAT AND SWALE DEPOSITS

The widespread occurrence of material of this type exists in the New Orleans area. These deposits are sensitive to expansive excavation and construction. It is believed that they may be extensive but in areas other than those in which the surface (Map Units I through L). Zones up to 4 ft in Map Units I and II, under certain circumstances can be expected to develop, especially toward lower water levels and a than the surficial soils.

Interdistributary, swamp, and other large pieces of undifferentiated Map Units I through L. Less frequent occurs in the lateral levee deposits (environment of deposit areas delineated by Map Units G through F). Well-preserved beach ridges as far as 10 to 15 ft have been encountered in areas of depths as great as 15 ft below the ground surface.

### RECHARGE CONDITIONS

General: The permanent water table in the New Orleans area lies from a depth of 0 to 1 ft below the ground surface. This is a function of the nature of the deposits of the land surface (average elevation = 5 ft above mean sea level) and relatively high precipitation (average annual rainfall =

Water tables in the predominantly clayey deposits very slowly. The variations that do occur are usually precipitation. The highest water tables occur in the deposits (see environment of depositions E and F). These the limits of artificial levee protection (Map Unit L) extend to a depth of at least several inches at various times to a depth of several feet during tropical storms (about 1 yr). The groundwater in the beach sand (environment of Units A, B, and C) is hydraulically connected with Lake Pontchartrain and becomes brackish at the lower depths during rainfall.

Hydrostatic pressures: Greatest fluctuations in the water point-bar deposits (environment of deposition 4, Map Unit Mississippi River). Highest water tables occur during spring on the river (17 to 20 ft msl) while lowest water tables are winter low-water stages (0 to 5 ft msl).

During high-water stages, excess hydrostatic pressure in the point-bar silts and sands. The periodic occurrences must be considered in foundation design and in deeper excavations greater than about 10 ft in depth are to be maintained stages, techniques must be employed that will prevent piping.

Similar hydrostatic pressures may occur in sand units of 30 ft. The effectiveness of the overlying clays or of venting seepage into an excavation and the need for reliable will vary considerably from one area to another and will for each particular site.

Chemical quality: In general, corrosion of steel piling piling is not a problem in the New Orleans area. Since most always high throughout the year, alternate wetting and drying normally does not occur. Where such exposure may occur, steel piling can be protected by a bituminous coating or numerous large buildings in the city are constructed on yellow pine piles which, after a period of 20 or more years, indications of rotting.

(MI) orality and (GM) literacy occur. The following is a transcript of the interview conducted at the site of the sweep areas.

Table 1. The experimental design. Models of predicted relationships between variables.

#### **4.2. The role of the model and the evaluation methods**

middle of March, 1913. Value, price less 2% of gross value, was \$1,000.

## 1. CONSIDERATIONS

and will in the New species have first and only all types of the resulting structures of a new type in the new genus. The new genus is thus distinguished from the old by the presence of the new structures.

卷之三十一

and the large number of women who have  
been in their districts, particularly those connected  
with the Government of Upper Canada, and in  
particular the well-known Mrs. F. G. Bond,  
have been instrumental in making  
the movement successful.

2022 RELEASE UNDER E.O. 14176

and in the low ridges were mostly varied. Below the ridges, however, the ridges themselves, the nature of the bed rocks, the low elevation ( $100-200$  ft above mean sea level), and the irregular annual rainfall ( $10-15$  in.) definitely slowed up tidal wave relatively little so that it was usually a result of most water tables rising in the marsh and swamp depressions (Fig. 1). These areas lying beyond the protection (Fig. 10) were frequently flooded 1-3 inches at various times throughout the year and some tropical storms "back rain" every 6 to 8 weeks (wind environment of Fig. 10). Map 10 is generally connected with Lake Pittwater and may at the lower depths during periods of low

est fluctuations in the water table occur in  
part of depression 4, W., (Unit B) adjacent to the  
water tables, occur during spring high-water stages  
() while lowest water tables occur during autumn  
(Fig. 5, small).

excessive hydrostatic pressures may be encountered and. The periodic occurrence of these pressures in design and in deeper excavations. If excavations in depth are to be maintained during high river stages that will prevent piping and sand boils. Cures may occur in sand units lying below a depth of the overlying clays or other materials in preparation and the need for relief of uplift pressures are area to another and will have to be determined.

, corrosion of steel piling or rotting of wood in New Orleans area. Since water tables are all year, alternate wetting and drying of the soil where such exposure might become a factor, by a bituminous coating or cathodic protection. The city are reconstructed on untreated, pebbled, sand particles of 20 or more years, have shown no

General. For the most part, all construction materials are produced in the New Orleans area. The only bulk materials locally exploited are the fine sand (CP) and gravel (CG) in the point-bar deposits (Map Unit D) and in the bed of the Mississippi River. This material is too poorly sorted for use as concrete or structural aggregate but is suitable for pervious fill. Gravel (Map Unit D) is widely available from natural river deposits (Environment Type Unit G).

London Gravels. The oldest commercial gravels of southern England for concrete and constructional purposes and still are located in Pleistocene terraces in the valley north of Newhaven. The sand and gravel are normally transported by the flow of water along incised waterways.

Considering my small quantities of holdings, the result is not representative with regard to me. The average composition of the Dow Jones Industrial Average is 12 percent stocks, 35 percent bonds, 11 percent cash, and 42 percent real estate. The bond percentage does not exceed 16 percent and cash does not exceed 10 percent.

and the following are the principal methods of protection:

the basin of the Pearl River, and the basin of the Min River in between, will be deep Pontochartrain, in the lower portion of Pearl river, and in the Min River. The sea is mentioned at a point, should occur at depths of 100 fms. or more. This sound is apparently better suited than the mouth of the Min River for a port city.

The shell is a small, pointed, elongated, slightly curved, smooth, white or yellowish-white, thin-shelled or thick-shelled, with a pointed apertural end (Fig. 11) found most frequently in the New Orleans area, and extending southward to the Gulf of Mexico. The shell is circular in outline by breaking in the bottom, and has a smooth surface, with no distinct suture, and a slightly irregularly shaped, pointed, slightly elevated, apertural end. The shell is about 1/2 to 1/4 of an inch long, and 1/8 to 1/4 of an inch wide.

and sandstone are the most difficult and expensive materials to transport south in the New Orleans area. The cheapest material is sand which is transported by barge from quarries in western Tennessee and Kentucky. In certain cases similar materials can be obtained relatively easily by rail from quarries in northern Alabama and Georgia. The best quality lime and sand fertilizer found in central Louisiana and Mississippi are obtained through railroads by rail or barge.

**Inventory and Distribution.** The following is a selected list of the major material stores of construction materials in the city of New Orleans:

## FOUNDATION ENGINEERING DATA

The foundation conditions which exist in the New Orleans area demand that thorough subsurface investigations be conducted for all large structures. Consequently, a large collection of boring logs, soils reports, and related data exists for the area. These data can usually be examined and/or obtained from numerous organizations or government agencies. A partial list of the more important agencies is as follows:

U. S. Army Engineer District, New Orleans, La.  
U. S. Army Engineer Waterways Experiment Station, Vicksburg, Miss.  
Orleans Levee Board, New Orleans, La.  
Louisiana Department of Public Works, Baton Rouge, La.  
Louisiana Department of Highways, Baton Rouge, La.  
New Orleans Railroad Terminal Board, New Orleans, La.

(Continued on last page)



## ENGINEER

In addition to the preceding sources, there are a number of foundation engineering firms or consultants which have had considerable experience in the area. A partial list of the larger firms having offices in the city is given below:

B. M. Dornblatt & Associates, Inc.  
ETCO Engineers & Associates  
Eustis Engineering Co.  
Gillen Engineering Co.  
McClellan Engineers, Inc.  
Nelson Wadsworth & Co., Inc.  
Timmer & Baker Engineers, Inc.



## REFERENCES

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Fink, H. N., "Recent Mississippi River Sedimentation and Peat Accumulation," Compte Rendu du quatrième Congrès pour l'avancement des études de Stratigraphie et de Géologie du continent. (Reims, 15-17 Septembre 1957) - 1958, pp. 177-199.

Jackson, R. C., Recent Geomorphic History of the Pantchartrain Basin, Louisiana. Coastal Studies Inst., Louisiana State Univ., Tech. Rep. No. 17, Baton Rouge, February 1953.

U. S. Army Engineers Waterways Experiment Station, Geological Investigation of the New Orleans Harbor Area, Tech. Memo. No. 3-391, Vicksburg, June 1954.

Geology of the Mississippi River Deltaic Plain, South-eastern Louisiana by J. R. Kelt and J. R. Van Lopik, Vicksburg, July 1952. (Tech. Rep. No. 3-422, 2 vols.).

Distribution of Soils Bordering the Mississippi River from Donaldsonville to Head of Passes, by J. R. Kelt. Tech. Rep. No. 3-401, Vicksburg, June 1952.

Works Projects Administration of Louisiana, Some Data in Regard to Foundations in New Orleans and Vicinity, New Orleans, 1937.

CHARACTERISTIC MATERIAL	ENVIRONMENT OF DEPOSITION	EXCAVATION CHARACTERISTICS
SP, SM	1, 2, 4	Excavation above water-table is easy and can be performed by conventional equipment if the low the water table must be dewatered.
M	2, 3, 4	See above.
CH, CL	3, 5, 6, 7	Difficulty generally increases with increased water protection.
St, SH	6, 8	Difficult under most conditions. Stumps and logs frequently present, particularly in swampy areas.

## ASPECTS OF SHELTER CONSTRUCTION

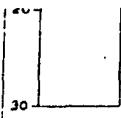
MAP UNIT	ENVIRONMENTS AND PREDOMINANT LITHOLOGIC UNITS	SHELTER TYPE	CONSTRUCTION ASPECTS	
			SHELTER TYPE I	SHELTER TYPE II
O	SP	1	Single-level, above-ground shelters. Designed for (a) family use, 1,200 sq ft, or (b) community use, 1,000 sq ft. Maximum floor depth is 2 to 3 ft below ground surface. Concrete or brick walls with concrete roof slab and a 3-ft earth cover are assumed. Walls will be protected by an earth fill at least 3 ft thick.	Multilevel, below-ground use, 2,000 sq ft. Concrete or brick walls 20 ft with roof a multilevel shielded cover and 4 ft thick.
A	SP	2	<p><u>Ala.</u> No excavation or dewatering problems should occur since the water table is generally more than 5 ft below surface. Sandy material removed from shallow excavations is excellent for fill when barged. However, used as an unprotected earth cover, the material is susceptible to wind and water erosion. Most of the necessary fill material must be hauled to the site.</p> <p><u>Ala.</u> In excavations below the normal water table (about 5 ft) provisions should be made for dewatering. The use of wellpoints is probably the most practical dewatering method. Assuming adequate dewatering, retaining excavation slopes of 1 on 1-1/2 should be satisfactory. Excavated material is suitable for backfill, fill cover (see section Ala above).</p>	

## ENGINEERING CHARACTERISTICS OF SOILS

IT	EXCAVATION CHARACTERISTICS	DEWATERING REQUIREMENTS	STABILITY OF EXCAVATION SLOPES	BEARING PRESSURES AND SETTLEMENT
	Excavation above water table is easy and can be performed using conventional equipment. Soils below the water table must be dewatered.	Dewatering required below the water table must be dewatered. Large diameter wells or wellpoint systems are required. Capacity of system based on maximum river strata anticipated.	Slopes of 1 on 1-1/2 for soils above the water table and, with effective dewatering, below the water table. Slopes of 1 on 3 for slopes subjected to emergent seepage.	Favorable foundation conditions. High bearing pressures may be used; values depend on size of footings. Settlements will be minor. Control of uplift pressures is necessary below the water table.
	See above.	Soils below the water table usually require dewatering. Wellpoint systems are usually adequate. Effective dewatering is sometimes difficult to attain.	Slopes of 1 on 3 for soils above the water table, and with effective dewatering, below the water table. Flatter slopes for slopes subjected to emergent seepage.	Favorable foundation conditions. Moderately high bearing pressures may be used. Settlements will be minor. Control of uplift pressures is usually necessary for foundations below the water table.
	Difficulty generally increases with increased water content.	None required, although pressure relief in underlying pervious strata is sometimes necessary. Surface water is controlled by ditches and pumps.	Vertical cuts to depth, $H_1$ : <ul style="list-style-type: none"> <li>Very soft clay, <math>H_1 \leq 5</math> ft</li> <li>Soft clay, <math>H_1 = 5</math> to 10 ft</li> <li>Medium clay, <math>H_1 = 10</math> to 15 ft</li> </ul> Design of slopes in clay is usually complex.	Bearing pressures medium to low. Settlement large to medium, depending primarily on water content and degree to which structure loads exceed loads previously imposed during glacial history.
	Difficult under most conditions. Clumps and lumps frequently present, particularly in swamps.	Very difficult to excavate. Drains or ditchies or wellpoints are sometimes satisfactory.	Flat slopes usually required, unless dictated by local experience. Bracing and shoring are usually not satisfactory if depth of deposit is great.	Unfavorable foundation conditions. Bearing pressures are very low and settlements as a rule very great.

## SHELTER CONSTRUCTION

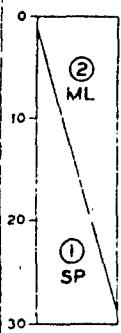
(a) family use, (b) community use, (c) sheltered	SHELTER TYPE 2	SHELTER TYPE 3
	Multi-level, below-ground shelters designed for community use, 2000 sq ft or more. Maximum floor depth is 10 ft. Concrete or brick walls extending to a maximum depth of 20 ft with two shelter levels which form the basement for a multi-story building, or are overlain by a concrete cover and an earth fill 3 ft thick.	Single-level, below-ground shelters designed for (a) family use, 100 sq ft, or (b) community use, 1000 sq ft. Maximum floor depth is 10 ft. Concrete or brick walls with concrete roof slab and a 3-ft-thick earth cover are assured. Above-ground walls to be protected by an earth fill at least 3 ft thick.
DESIGN ASPECTS		
Soil is generally more than 5 ft to far fill when barged. When water erosion. Most of the		Abs. sand will support structures with little settlement resulting. Slab- or footer-type foundations will be adequate for family-type shelters. Footings normally will be required for larger structures. Allowable bearing pressures are relatively high.
would be made for dewatering, during adequate dewatering, is suitable for backfill and		Abs. The depth of the foundation should be influenced by the amount of material required for cover and backfill. No settlement of structures is anticipated. Slab-type foundations should be designed to withstand anticipated uplift pressures, or adequate provisions should be made for relief of these pressures.



**3**

**3** Min. A substantial dewatering system, probably consisting of wellpoints, will be required. Excavation slopes of 1 on 2 should be satisfactory. Where size of excavation is restricted by adjacent buildings, etc., sheeting or bracing may be required, and disposal of soil may be a problem.

**B**



**1**

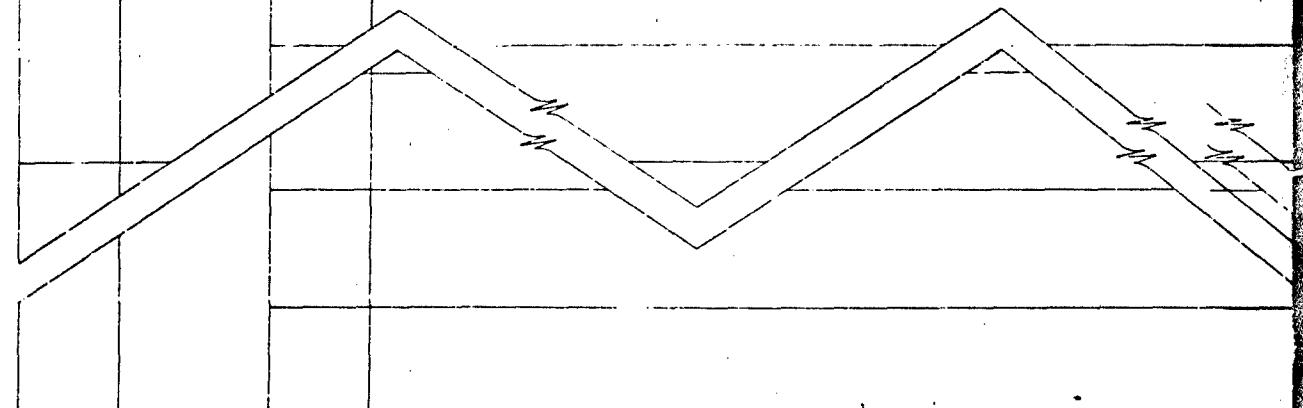
**3** Min. If excavation or dewatering problems should occur since the water table is generally more than 5 ft below surface, materials excavated from either environment of deposition can be used for fill if required. For further information concerning earth fill, see section A4a above.

**2**

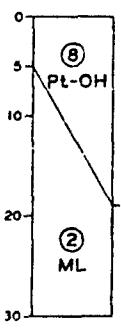
**3** Min. In excavations below the normal water table (about 5 ft), control of groundwater should not be aid nor feasible. Well points, ditches and sump will be required; the type will depend on the nature of the soil. Excavation slopes between 1 on 2 and 1 on 3 should be satisfactory. Determination of slopes will depend primarily on the nature and the use of the soil in environment of deposition. This type of fill will be suitable for backfill and cover if compacted by power tampers.

**3**

**3** Min. Provision must be made for dewatering of the excavation. Wellpoints will probably be the most satisfactory method. Assuming adequate dewatering, excavation slopes of about 1 on 2 or 1 on 3 should be acceptable. Final determination of the most practicable excavation slopes will depend on the local subsurface lithology. Where size of excavation is restricted by adjacent buildings, etc., sheeting or bracing may be required, and disposal of soil may be a problem.



**L**



**1**

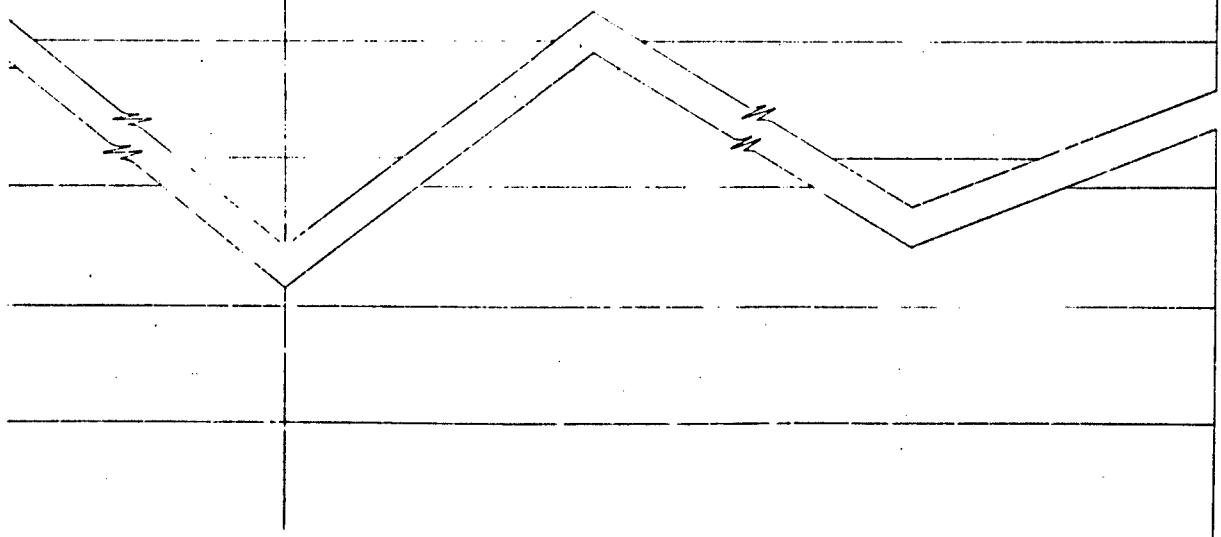
**2**

**3**

Construction of shelters of any kind in this unit is inadvisable. Minimal control of surface water, building removal and waste of unconsolidated material, transportation of large quantities, and treatment would be required. Construction in these areas is therefore prohibited.



<p>III is required, excepting that by adjacent buildings, etc.</p> <p>In the generally more than 10 feet of soil still to be excavated.</p> <p>Underwater condition is con- sidered. Material will depend on water temperature. Depth 1 in 10 segment of 1 ft. at water temp.</p> <p>It will probably be the most costly method will depend on the location of site, etc., showing or terrain may re- quire extensive earthmoving.</p>	<p><u>A-3.</u> Block-type foundations would be sufficient to withstand anticipated uplift pressures, or adequate pro- tection could be provided by sheet piling or cofferdam protection, depending on the extent and character of underlying soil. (See A-1 for depth, material, etc., necessary protection for military structures.) File foundations recommendation of differential settlement would be significant. A possible alternate method would be to design the structure with a timber-type foundation. Weight of structure is reduced by weight of excavated material. Actual cost experienced in timber foundation is desired (for location engineering data sections).</p> <p><u>B-3.</u> Sand in environment of deposition will support structures with little settlement resulting. Some experimental settlement may occur if significant amounts of fine-grained materials in environment of deposition occur beneath the foundations. Clay in fine-grained material is generally will be adequate for cast-type bottom, which generally will be a price for larger structures. Allowable bearing pressure can be relatively low due to the nature of deposit in environment of deposition.</p> <p><u>C-3.</u> The depth of fill will modify the amount of material required for cover and back- fill. The differential settlement may depend on the placement of fill and backfill; the amount of settlement will largely depend on the quantity of fine-grained material present below the foundations (environment of deposition). Cast-type foundation should be designed to withstand anticipated uplift pressures or adequate protection can suffice in view of nature of these pressures.</p>
--	---



construction of shelters of any type in the area designated by this  
part is inadvisable. It would require clearing of vegetation,  
control of surface water, building of access roads, flood protection,  
removal and storage of up to 1' ft of organic peat and muck, and im-  
migration of large quantities of fill. Extensive and costly founda-  
tion treatment would be required. A favorable aspect of shelter con-  
struction in these areas is the generally lower land acquisition costs.



## **EXISTING FALLOUT SH**

DECEMBER 1982

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257 229  
100 230  
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3

3

# G FALLOUT SHELTERS

DECEMBER 1962

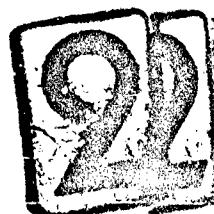
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62 64 & 65  
55 11  
37 54 58  
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14



The fallout shelters designated on this map were established as a result of Phases 1 and 2 of the nationwide Fallout Shelter Survey and Marking Program conducted by the U. S. Army Corps of Engineers. The data included herein were furnished by the Orleans Parish Civil Defense Director, New Orleans, La.

#### DESIGNATED SHELTERS

	Capacity (Persons)
1. BARONNE BLDG. 305 Baronne St.	1463
2. BURTON MEMORIAL HOME 3320 S. Carrollton Ave.	180
3. CIVIL COURTS BLDG. Loyola Ave.	530
4. GALLAGHER STORAGE 945 Magazine St.	171
5. GHISALBERTI APTS. 3405 St. Charles Ave.	56
6. GIBBONS FEED BLDG. 2700 Howard Ave.	81
7. HIBERNIA NATIONAL BANK 812 Carver St.	2278
8. INTERNATIONAL HOUSE 607 Gravier St.	1585
9. MRS. MARY KELLY - KELSTO CLUB	196
10. LEE CIRCLE BLDG. 1040 St. Charles St.	479
11. LEHMAN NOVELTY CO. 301 Decatur St.	101
12. LOUBAT GLASSWARE CO. LTD. 516 Bienville St.	309
13. LA. STATE OFFICE BLDG. 325 Loyola Ave.	597
14. *LSUNO GENERAL CLASSROOM Lakeshore Drive	160
15. *LSUNO SCIENCE BLDG. Lakeshore Drive	hope for
16. LA. STATE WELFARE DEPT. 915 Lafayette	Lafay
17. LA. WILDLIFE & FISHES BLDG. 418 Royal	Roya
18. MAYFLOWER APTS. 2203 t. Charles Ave.	Charles
19. METER MEMORIAL 211 Camp St.	Charles
20. MUNICIPAL AUDITORIUM 1201 St. Peter St.	St. Peter
21. NEW ORLEANS CITY HALL 399 Perdido St.	Perdido
22. NEW ORLEANS PUBLIC LIBRARY 215 Loyola Ave	Loyola
23. NEW ORLEANS PUBLIC SERVICE INC. 317 Baronne	Baronne
24. PONTCHARTRAIN HOTEL 2031 St. Charles	St. Char
25. QUEEN A CHESCENT BLDG. 344 Camp St.	A Camp
26. LOOSEVILLE HOTEL 120 University Pl.	University Pl
27. ST. ELIZABETH SCHOOL 1314 Napoleon Ave	Napoleon
28. ST. VINCENT HOSPITAL 1507 Magazine St.	Magazine
29. SEARS, ROEBUCK & CO. 201 Baronne St.	Baronne
30. STEPHEN CHEVROLET CO. 840 Carondelet St.	Caronde
31. TOURO CONVALESCANT PAVILLION 3516 Prytania	Prytania
32. UNITED FRUIT CO. 321 St. Charles St.	Charles
33. VETERANS HOSPITAL 1601 Perdido St.	Perdido St
34. MOHR APTS. 211 St. Charles Ave.	Charles Ave.
35. Y.M.C.A. 936 St. Charles St.	Charles St.
36. WHITNEY BANK BLDG. 226 St. Charles St.	Charles
37. PAN AMERICAN BLDG. 610 Poydras St.	Poydras St
38. LAPALETTE HOTEL 628 St. Charles St.	Charles
39. Y.W.C.A. 929 Gravier St.	Gravier St



KCE BLDG.	Lakeshore Drive	144	41.	DILLARD UNIVERSITY	2601 Gentilly Blvd.	78
ELFARDE DEPT.	315 Lafayette St.	1097	42.	SARATOGA BLDG.	212 Loyola Ave.	--
E & FISHERMAN BLDG.	415 Royal St.	1922	43.	NICECLES SCHOOL	1820 St. Claude Ave.	--
JFD.	240 St. Charles Ave.	2073	44.	WRIGHT HIGH SCHOOL	1446 Napoleon Ave.	--
MAIL	114 Camp St.	247	45.	PABOIN HIGH SCHOOL	715 Carondelet St.	--
MUTTOREN	1701 St. Peter St.	1670	46.	MOSS SCHOOL CLINIC	214 Girod St.	--
CITY HALL	399 Ceridu St.	1260	47.	B. T. WASHINGTON SCHOOL AUDITORIUM	1201 St. Roman St.	--
PUBLIC LIBRARY	215 Loyola Ave.	931	48.	MC MAIN HIGH SCHOOL	2815 Nashville Ave.	--
PUBLIC SERVICE INC.	347 Baronne St.	1495	49.	JACKSON SCHOOL	1408 Camp St.	--
INN HOTEL	2031 St. Charles Ave.	56	50.	LAUREL SCHOOL	841 Phillip St.	--
ZCFTN BLDG.	34 Camp St.	495	51.	LUSHER SCHOOL	7331 Willow St.	--
ETEL	125 University Pl.	29,621	52.	BAUER-NICHOLAS BLDG.	703 Carondelet St.	--
TH SCHOOL	131 Napoleon Ave.	288	53.	COMMERCE BLDG.	821 Gravier St.	--
HOSPITAL	1527 Magazine St.	254	54.	CHERATON-CHARLES HOTEL	213 St. Charles St.	--
LOCK & CO.	201 Baronne St.	4168	55.	MARY ISAACS CO.	715 Canal St.	--
WHOLEY CO.	340 Carondelet St.	768	56.	U.S. POST OFFICE	600 Camp St.	--
LESANT PAVILLION	3516 Prytania St.	281	57.	POST OFFICE - FEDERAL BLDG.	701 Loyola Ave.	--
AUX PAVILLION	3516 Prytania St.	438	58.	U.S. CUSTOM HOUSE	423 Canal St.	--
T CO.	361 St. Charles St.	2589	59.	FEDERAL OFFICE BLDG.	600 South St.	--
SPITAL	1601 Perdido St.	4368	60.	TIMES-PICATURE CO.	615 North St.	--
211 St. Charles Ave.	818	818	61.	MONTLEONE HOTEL	208 Royal St.	--
36 St. Charles St.	498	498	62.	MONTLEONE HOTEL ANNEX	202 Royal St.	--
K BLDG.	226 St. Charles St.	16,904	63.	MONTLEONE HOTEL ANNEX	228 Royal St.	--
M BLDG.	510 Poydras St.	1643	64.	MONTLEONE GARAGE	623 Bienville St.	--
ETEL	620 St. Charles St.	364	65.	MONTLEONE GARAGE	624 Bienville St.	--
G9 Gravier St.		499	66.	URSULINE CONVENT	2635 State St.	--

\* Not shown on this map.

